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DEPARTMENT OF THE ARMY

DOMESTIC TECHNOLOGY TRANSFER

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ANNEX A

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94-10609

November 1993

Section 4224, Public Law 102-484, October 23, 1992

This report responds to the above statute. It is an assessment of the potential of certain designated Army activities to promote technology transfers, and recommendations on the manner in which each such activity might better promote such transfers.

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INTRODUCTION

This report is submitted in partial satisfaction of the requirements of Section 4224 of the Defense Authorization Act (Public Law 102-484). The subject section requires the following:

- (1) An assessment of the potential of each defense laboratory to promote the transfers described in 2514(c) of the title 10, United States Code, as added by subsection (a).
- (2) Recommendations on the manner in which each such laboratory might better promote such transfers. [This describes what each lab is planning to do to improve.]
- (3) A description of the extent to which each such laboratory has implemented effectively the plan established for the laboratory under subsection(c) during the year preceding the date of the report. [This initial report states what the labs are doing and will serve as a baseline for subsequent reports.]
- (4) Recommendations of the Secretary for improvement of the Federal Defense Laboratory Diversification Program established pursuant to such section 2514(c).

In compliance with Section 4224, this report describes the capabilities and efforts of the designated Army activities to conduct technology transfer with the private sector. Designated activities have been selected based upon the criteria specified by Congress; namely, laboratories whose direct funded Research, Development, Test, and Evaluation (RDT&E) budget is more than \$50M. The Army Research and Development (R&D) activities so selected are:

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)

AVIATION RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (AVRDEC)

BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (BRDEC)

COMMUNICATIONS-ELECTRONICS COMMAND RESEARCH, DEVELOPMENT AND
ENGINEERING CENTER (CERDEC)

EDGEWOOD RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ERDEC)

MISSILE COMMAND RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (MRDEC)

NATICK RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (NRDEC)

ARMY RESEARCH LABORATORY (ARL)

SPACE AND STRATEGIC DEFENSE COMMAND (SSDC)

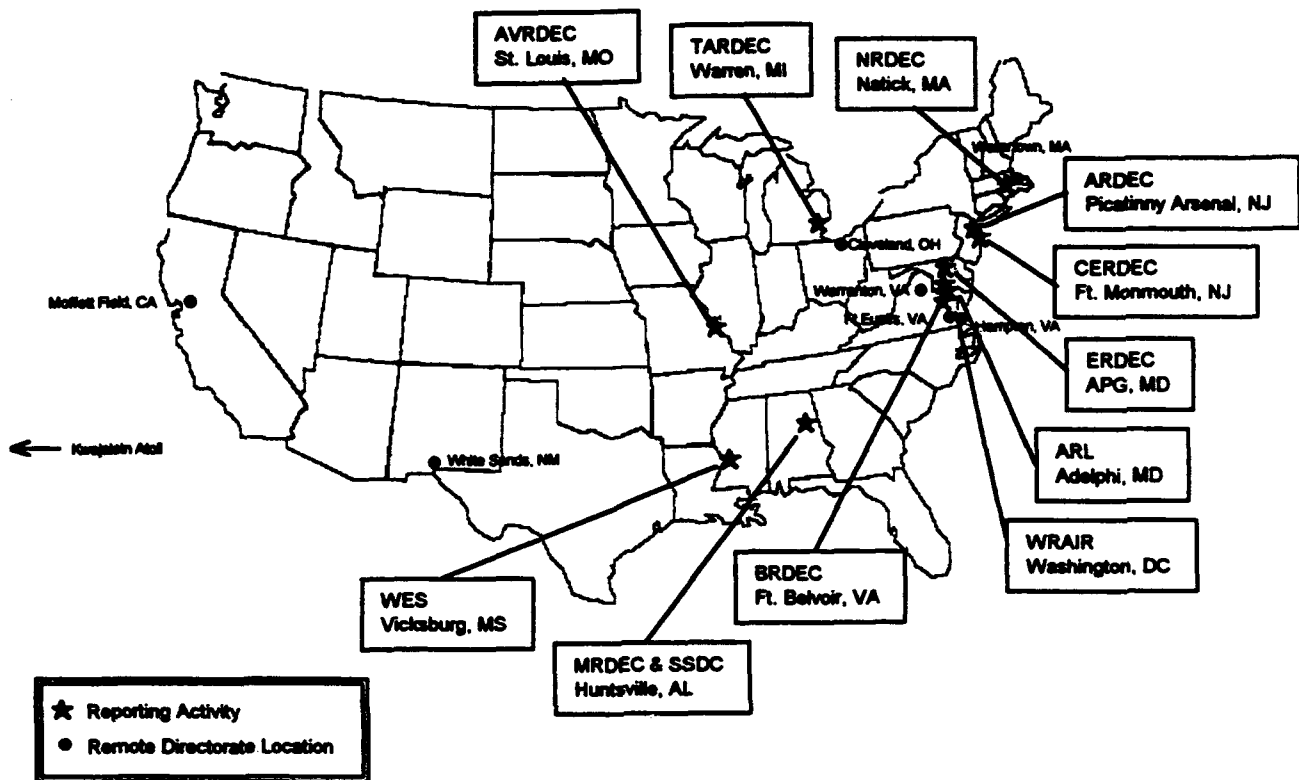
TANK-AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (TARDEC)

WATERWAYS EXPERIMENT STATION (WES)

WALTER REED ARMY INSTITUTE OF RESEARCH (WRAIR)

INTRODUCTION (Continued)

Locations of Designated Army Reporting Activities



Remote Directorates and Their Locations

Aviation RD&E Center
Aeroflightdynamics - Moffett Field, CA
Aviation Applied Technology - Ft. Eustis, VA

Communications-Electronics Command RD&E Center
Intelligence & Electronic Warfare- Warrenton, VA
Night Vision Electronic Sensors - Ft. Belvoir, VA

Space & Strategic Defense Command
Kwajalein Missile Range - Kwajalein Atoll
High Energy Laser Systems Test Facility - White

Sands, NM
Army Research Laboratory
Advanced Computational and Information Sciences - APG, MD
Battlefield Environment - White Sands, NM
Electronics & Power Sources - Ft. Monmouth, NJ
Human Research and Engineering - APG, MD
Materials - Watertown, MA
Survivability/Lethality Analysis - APG, MD
Vehicle Propulsion - Cleveland, OH
Vehicle Structures - Hampton, VA
Weapons Technology - APG, MD

It is important to note that many other Army activities actively participate in Domestic Technology Transfer but do not have a direct funded RDT&E budget of more than \$50M and therefore are not represented in this report.

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INTRODUCTION (Continued)

The activities presented in this Annex, as well as the other Army R&D activities, are fully coordinated in their Domestic Technology Transfer efforts. The Army Domestic Technology Transfer Program Manager has ensured that all of the Offices of Research and Technology Application (ORTAs) have a common sense of the direction in which they should be concentrating their efforts. This coordination has enabled the Army as a whole to excel in Technology Transfer, rather than just a few activities.

The Army considers Technology Transfer to be a very broadly defined term consistent with the Stevenson-Wydler Technology Innovation Act of 1980. A key element of the Army's Technology Transfer program is, and always been, based on developing cooperative R&D efforts. These collaborative efforts include Cooperative Research and Development Agreements.

The report is structured into two sections as follows:

Section I includes, for each of the twelve Army activities, summary sheets which detail the particular activity's areas of expertise and their unique facilities. The summary sheets are followed by data sheets which describe the activity's efforts in technology transfer. These sheets do not completely describe the activity's efforts but provide examples of certain types of efforts that they are performing and how they relate to technology transfer. Finally, there are each activity's plans for enhancing technology transfer for FY 1994.

Section II describes a few success stories of Army technologies commercialized by the private sector.

SECTION I

ASSESSMENTS OF THE TECHNOLOGY TRANSFER POTENTIALS AND FUTURE PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER OF DESIGNATED ARMY ACTIVITIES

U.S. ARMY ARMAMENT RD&E CENTER

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ORGANIZATIONAL AREAS OF EXPERTISE

Systems - Life-cycle engineering for large systems.

Electronics - Electronics design and test, computing science, and algorithms.

Electrical Systems - High energy electrical systems, design and test.

Sensors - Sensor systems fusion design/facilities for acoustics, infrared (IR), millimeter waves (MMW), magnetic, radio frequency (RF).

Quality Assurance - Complete quality assurance systems management, non-destructive testing including X-Rays for large objects.

Materials - Materials engineering in organic, metallic and ceramics areas.

Chemistry - Complete chemical laboratory/facilities.

Energetics - Formulation, analysis and testing of energetic materials.

Manufacturing - Engineering expertise and equipment for limited/large quantity manufacturing.

Environmental Engineering - Pollution prevention engineering, waste stream reduction.

Packaging - Environmental sensitive industrial packaging.

Plastics - Technical evaluation center for the Department of Defense.

Testing - Engineering expertise and facilities for environmental, electrical, mechanical and non-destructive testing.

UNIQUE FACILITIES

Propellant Surveillance Facility - Facility is equipped with heated chambers where large quantities of propellants can undergo aging tests to determine the safe lifetime of gun propellants.

U.S. Army Armament RD&E Center (Continued)

Explosives and Warhead Development Facility - The energetics laboratory was built in the early 1980s, for synthesis, analysis, and characterization of energetic materials. Warhead designs are developed by using 2D and 3D hydrodynamic codes.

Environmental Test Facility (Explosive) - The facility is a specially constructed building approximately 500 ft. long for the environmental testing of explosively loaded munitions and hazardous materials, wherein environments which may be generated are vibration, mechanical shock, high/low temperature, humidity, altitude, and pressure.

Propellant Fabrication and Test Facility - The facility permits the development of a propellant from a concept to the point where it can be type classified. These R&D facilities include explosion proof hoods with blow-out windows, a multi-million dollar instrumentation suite including Infra-Red, Ultra-Violet, Nuclear Magnetic Resonance Spectrophotometer, High Performance Liquid Chromatograph, Gas Chromatograph/Mass Spectrograph, Liquid Chromatograph/Mass Spectrograph, Chromatographs, Electron Spin Resonance, and X-ray and Raman spectrometers.

Armament Technology Facility - Presently under construction, ARDEC's new Armament Technology Facility (ATF), is scheduled to be operational in January 1994. The ATF will be the Army's premier development site for small and cannon caliber (through 40mm) armament systems. The ATF will provide ARDEC and the U.S. Army with a unique, world-class small arms and automatic cannon caliber weapon system development facility.

Radiological Facility - This facility is dedicated to the application and development of industrial radiography and other forms of non-destructive testing for use in evaluating armament items. It represents a unique combination of laboratory and production capabilities, as well as combining the handling of explosive (up to 5,000 pounds) with the operation of high energy x-ray and other radiation equipment.

Electric Armaments Research Facility - This world class center is capable of firing both Electro Thermal Chemical and Electro Magnetic guns and has the appropriate level inflight and in bore measurement/instrumentation systems available for data gathering and reduction.

Instrument Laboratory Suite - A suite of seven laboratories dedicated to the development of measurements in support of armament. Fields of analysis include signal analysis, microprocessor system, analog and digital hardware design, and radar. Work accomplished within the suite has earned 3 patents, the Picatinny Arsenal Award, and the Department of the Army Research and Development Achievement Award.

Imaging Processing Laboratory - Laboratory dedicated to the development of measurement systems based on imaging analysis techniques to support armament development. Recently completed a project that improved remote optical measurement accuracy by over an order of magnitude; this work has been nominated for the Department of the Army Research and Development Achievement Award.

Telemetry Engineering Facility - This facility is dedicated to the design and development of high performance telemetry hardware; capable of withstanding the set back forces associated with the firing of artillery projectiles. This work has yielded over a dozen patents and the publication of many technical papers.

U.S. Army Armament RD&E Center (Continued)

Radar Cross-Section Measurement Facility - This facility is dedicated to the measurement of the radar reflecting signature of projectiles and small rockets. The radar has the highest resolution of any facility in the Department of the Army. This facility was pivotal in the ability to measure the performance of highly dynamic projectiles.

Molecular Beam Epitaxy/Integrated Optics Facility - Suite of three laboratories dedicated to optoelectronics research for fire control/smart munitions. This facility provides a total integrated optics research capability for design, fabrication, and evaluation.

Anti-Tamper Technology Exploratory Development Facility - This facility is used for exploratory development and fabrication of thin film electronic devices for tamper protection of electronics. This facility includes a 2500 square foot Class 100 cleanroom.

Air Gun - An interior ballistic simulation facility contains 2 inch and 5 inch gas guns that provide high-g, unidirectional accelerations, and a 155MM gun that gives both angular and linear accelerations.

Billion Dollar Prototype Facility - Collocated at Watervliet Arsenal, the Army's only manufacturer of thick wall cannons with the capability for the production of tube forgings in the rotary forge integrated line for the complete fabrication of cannon designs ranging from bore sizes of 40MM to the Navy's 16 inch gun.

Fabrication Facility - The uniqueness of this facility is in the varied type and quality of equipment as well as the building in which the shop is housed. The facility is approximately 120,000 square feet with three bridge cranes (50 ton, 25 ton, and 20 ton capacities) that transverse the length of the main building. These allow large vehicles to be moved throughout the building for modification.

Weapons Evaluation Facility - Provides a total weapon system evaluation utilizing ballistic rail gun, drop tower, shock tower, vibration, fragmentation, power gymnasticator, thermal shock, vacuum and electromagnetic/radio frequency interference (EM/RFI) testing.

U.S. Army Armament RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

ARDEC laboratories are located in Picatinny Arsenal, NJ with a small group, Benet Laboratories, Close Combat Armaments Center located off-post at Watervliet Arsenal, NY. The ORTA at ARDEC, Picatinny Arsenal supports the following:

Fire Support Armaments Center
Close Combat Armament Center
Armament Engineering Directorate
Production Base Modernization Activity
Product Assurance and Test Directorate
Other mission and support offices/activities

One full-time ORTA services the Benet Laboratories and three part-time persons provide support to the ORTA, Picatinny Arsenal. Total ARDEC ORTA effort including Benet Laboratories is 2.5 years. The ORTA budget for FY92 was \$200K and \$240K for FY93.

Aggressive actions were pursued on the part of the ARDEC ORTA's along the Domestic Technology Transfer guidelines for marketing technology, Expo participation, patent licensing, CRDA's and other transfer mechanisms. Part-time services of a marketing expert were obtained to assist accelerating ARDEC's cultural change.

Publicity:

- * Fact Sheets on individual programs
- * Participated in trade shows
- * Hosted seminars
- * Direct contact at all levels between ARDEC personnel and industry/academia

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	162	98

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	252	179

U.S. Army Armament RD&E Center (Continued)

Typical Publications and Forums:

- * Aerospace Sensing and Proceedings
- * American Chemical Society Proceedings
- * Defense Helicopter World
- * International Artillery Symposium Proceedings
- * Journal of Physical Chemistry
- * Topical Meeting on Surface Roughness and Scattering Proceedings

Selected Titles:

- * *Development of Molybdenum Shaped Charge Liners Producing High Ductility Jets*
- * *A Nonlinear Flexible Point System for Digital Control Research*
- * *Projectile Tracking System Housing Design and Mounting Method & Proceedings*
- * *Non-Destructive Testing of Thick Composite Structures*
- * *The Readiness Growth Model: A Quantitative Analysis of Software Risk*
- * *Advanced Field Artillery System (AFAS) Single Weapon Time-on-Target (TOT)/Rate-of-Fire (ROF) Effectiveness Analysis*

CONFERENCES AND SYMPOSIA

<u>CONFERENCES AND SYMPOSIA</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Attended	7	13

Selected Conferences and Symposia:

- * General Electric Armament Systems Department Independent Research and Development Review, Burlington, VT
- * Thiokol Independent Research and Development Review, Picatinny, NJ
- * 1993 Predictive Technology Symposium and Exhibition, Orlando, FL
- * 28th Annual Guns and Ammunition Technical Meeting, Monterey, CA
- * Simulation Conference, Randolph, NJ
- * 43rd Annual Bomb and Warhead Technical Meeting, Albuquerque, NM
- * AFAS/FARV Future Armored Resupply Vehicle Technology Days for Industry, Parsippany, NY
- * Ammunition Summit, Tysons Corner, VA

EXCHANGE PROGRAMS

ARDEC is an active participant in exchange programs. As example, ARDEC has effected a six month exchange of our Public Information Office (PIO) officer with a New Jersey Pharmaceutical company.

U.S. Army Armament RD&E Center (Continued)

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
136	\$39.3 M	67	\$37.8 M

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

A program to donate equipment to universities including Historically Black Colleges and Universities (HBCU) is being structured in 1993.

URI and Centers of Excellence:

	<u>FY92</u>	<u>FY93</u>
University of Pittsburgh - National Defense Center for Environmental Environmental Excellence	\$5.0 M	\$24.0 M
University of Rochester - Center for Optics Manufacturing	\$5.4 M	\$0.2 M
University of Texas - Center of Electro Mechanics	\$6.6 M	\$8.0 M

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
FY92		FY93	
PHASE I	PHASE II	PHASE I	PHASE II
\$885 K	\$4,565 K	\$962 K	\$5,541 K

USE OF LABORATORY FACILITIES

ARDEC Laboratory facilities are utilized for mission support and minimally used by industry. Occasionally, a contractor will use the facilities in the course of performance of an Independent Research and Development project. The Bailment Agreement is the mechanism that is employed for this use of the facilities. The Bailment Agreement is a type of licensing agreement that allows for the use of the facilities and equipment at no cost, so long as they are returned in the same shape as they were received.

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
4	6

U.S. Army Armament RD&E Center (Continued)

Active CRDA's Titles:

- * *To develop environmentally conscious manufacturing tools consortium*
Partner: Government/Industry
- * *To develop non-destructive technology applications for bridges and highway construction*
Partner: State/Government
- * *To develop and commercialize a motion alarm device which will sense onset of epileptic seizure in infants*
Partner: Health Industry
- * *To develop composite material applications for Mass Transit System*
Partner: Industry

Non-Monetary Contributions:

- * Personnel to evaluate partners and technical requirements
- * Facilities and equipment expected in the future

Reasons for Backlog:

- * Time required to develop and negotiate intellectual property
- * Time required to develop and negotiate liabilities
- * Time required to develop and negotiate data rights and releases

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
19	42	1	\$899.98

Selected Patent Titles:

- * *Collision Centrifugal Atomization Unit; 5,149,063*
- * *Nitrocubanes; 5,214,222*
- * *Method and Device for Measuring Fluid Velocities; 5,218,866*
- * *Slide Safety Stop for Pistols and Other Small Arms; 5,129,172*

Selected Patent Application Titles:

- * *System for Analyzing Measurement Data*
- * *An Insensitive Energetic Material*
- * *Coaxial SCR Switch*
- * *High Temperature Superconducting Electromagnetic Light Sensor*

Number of CRDA's That Provide Trade Secrets: 4

Backlog in Patent Applications: ARDEC has a backlog of 58 patent applications which is due to the loss of one attorney. There has been one unfilled GS-13 patent attorney position since October 1992 which is expected to be filled in the very near term.

U.S. Army Armament RD&E Center (Continued)

Attorneys Supporting DTT: The normal staff consists of three patent attorneys located at Picatinny which handle all intellectual matters for the former AMCCOM including Rock Island, Picatinny Arsenal, Watervliet, and Edgewater Arsenal. The present cumulative salary is \$208,934.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

ARDEC was an active participant in the TRP for 1993. Approximately 50 Technical Topics were identified and partnering was pursued with ten TRP submissions resultant. ARDEC offered ten engineers to the Advanced Research Projects Agency (ARPA) for TRP proposal reviewer assignments.

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * Work with the Department of Energy in the form of cooperative technical program development.

Typical Interactions with State and Local Governments:

- * Signed a Memorandum of Understanding with the Science and Technology Commission of New Jersey on 28 April 1993.
- * A specific technology oriented agreement has been signed with the State of New York.

Typical Interactions with Industry:

- * Contractor Independent Research and Development Program where ARDEC interfaces with more than 50 Companies.
- * An advisory panel composed of industry executives regularly meets with ARDEC management.

Typical Interactions with Academia:

- * Hosts the Science and Technology Commission meeting which is composed of academia, industry, and state executives.

U.S. Army Armament RD&E Center (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

In 1994, we will improve our DTT process, structure a plan, devise a data collection and access system that will allow easy access to DTT data for identification of ARDEC technology and management reporting, and apply technology marketing techniques to ARDEC intellectual property.

Facets of the ARDEC DTT 1994 Program will include:

1. **Completion of ARDEC Wide DTT Policy and Procedures Manual**

The product of this effort will be a single document that all personnel can use as a source book for Domestic Technology Transfer and will include streamlined procedure outlines, forms for the initiation of negotiation, and DTT process suggestions for ARDEC.

2. **Training of ARDEC Staff**

Completion and presentation of a DTT training program that will cover:

- * Intellectual property for scientists and management
- * CRDA and Patent Licensing Agreements (PLA) contents and operation
- * Technology evaluation from a business perspective
- * Dual-use planning considerations for ARDEC research projects
- * Guidelines for formation of ARDEC and private sector cooperative teams for proposal considerations.

3. **Intellectual Property Inventory**

Building on the skills transferred during staff training, an inventory of ARDEC intellectual property and a commercialization assessment will be created using the data base already created by DoD Form 1498. A commercialization rating scale will be developed as part of our overall plan process. It will combine the ownership of technology with the potential for commercialization.

4. **Marketing**

Utilizing the technology with the highest commercialization rating emerging from the intellectual property inventory as a start point, we will apply technology push and pull techniques to reach businesses and institutions that are likely candidates for technology transfer. We will utilize both ARDEC sponsored and other's expositions and conventions, technical presentations by our scientists and other word of mouth opportunities, linkages with professional organizations likely to be interested in our technology, and where appropriate, direct mail, and magazine and newsletter articles.

U.S. Army Armament RD&E Center (Continued)

5. Outreach Efforts

ARDEC DTT initiatives will be offered at every reasonable occasion, including the New Jersey Small Business Expo, the ARPA/ARDEC environmental exposition, the AMCCOM Advanced Planning Briefing for Industry, the AUSA Exposition in Washington, D.C., and the NASA TECH 2003 exhibition. This group represents our first quarter schedule. Interactions have been initiated with the signing of a Memoranda of Understanding (MOU) with similar state and local government organizations in 1994.

6. Technology Data Base

We intend that this system will be utilized by those needing to review the technology, facilities, and equipment available at ARDEC for possible CRDA use, by management to determine and monitor the status of each DTT project to avoid missing deadlines and by those needing to generate reports on the overall progress of our DTT program. This system will also be very useful to the legal office for patent actions. ARDEC will work with another Federal agency that has developed a technology transfer data handling system.

7. Laboratory Facilities and Equipment Data Base

ARDEC has a very substantial amount of special and expensive equipment. When businesses and institutions need assistance as part of a DTT project, or use of special equipment, a centralized inventory of facilities and equipment will be available to assist all parties. We intend this inventory to be especially useful to small businesses seeking assistance.

8. Standard Form CRDAs and PLAs

The basic Army CRDA is a 13 page, single spaced, contract that is nicely crafted for a straight forward business/ARDEC technology transfer project. It is not as appropriate for the usual ARDEC/University or ARDEC/State technology sharing project or a multiple party cross-licensing developmental project. Three different base-line CRDA forms will be prepared and made available to all ARDEC personnel in the ARDEC DTT manual to serve as examples. The same process will be applied to the PLA. The goal of our DTT program is to involve each individual scientist and engineer in the DTT process. All must be comfortable with CRDAs and PLAs and must understand the general purpose of each type of agreement. After discussions with a business or other institution, each scientist or engineer should be able to select one of the CRDA or PLA forms for use as the negotiating strawman so that a reasonable draft CRDA can be created between the scientist and the private party for rapid management review and approval. This approach intends to reduce the time all parties must spend on CRDA formation and to utilize the thousands of scientists and engineers instead of creating extensive bottle necks at management and legal offices.

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ORGANIZATIONAL AREAS OF EXPERTISE

Aeromechanics - Aerodynamics; design methodology; performance/airloads; vibration; structural dynamics/stability/loads; computational fluid dynamics (CFD); handling qualities/flight controls; and aeroacoustics.

Structures - Structural analysis; composite manufacturing; structural dynamics; structural integrity; maintenance repair techniques; crashworthiness testing; fatigue testing of rotor blades; and static/dynamic testing of rotorcraft components.

Airvehicle Design - Aircraft preliminary design; system synthesis and analysis; and advanced concepts study.

Propulsion - Turboshaft engine/drive system technology; aero/thermodynamic/mechanical design, analysis, and test of engine components and controls; engine environmental protection system; bearings/seals/gears; advanced material application; turboshaft engine performance cycle analysis; mechanical systems; and propulsion system integration/performance analysis.

Simulation - Simulations and simulators to represent complex Army aviation systems; evaluation of simulator quality and effectiveness; high fidelity engineering/manned simulation capabilities; design of experiments in the simulation environment; and the interface of engineering simulation with dissimilar fidelity simulators in distributed integrated simulation applications.

Human-Machine Integration - Computer-aided design and analysis.

Airworthiness - Qualification, test, and evaluation; and system specification compliance.

Systems Integration - Rotorcraft subsystems to include visionics, weapons, flight controls, avionics, control displays, passive/active survivability concepts, engines/drivetrains, rotors, airframes, and secondary systems.

Reliability/Accountability - Expert systems for aircraft maintenance; combat maintenance techniques (rapid repair) for helicopters; field repair of composite materials; on-board diagnostics for mechanical systems; turbine engine ground test systems and procedures; aviation ground support equipment; and helicopter external cargo handling systems.

Survivability/Vulnerability - Analysis, simulation, modeling, and testing for both passive and active threats.

U.S. Army Aviation RD&E Center (Continued)

UNIQUE FACILITIES

Aeromechanics:

Subsonic Tunnel - Wind tunnel (14' x 22'), Vertical/Short Take-Off and Landing (VSTOL), 200 knots, variable test section, flow visualization and diagnostics, acoustics capability, and hover cell.

40' x 80' x 120' Wind Tunnel - Wind tunnel with full-scale test capability (maximum 300 knots for 40' x 80' and maximum 100 knots for 80' x 120').

7' x 10' Wind Tunnels - Flow visualization, low speed (200+ knots) tunnel, control response, and maneuverability.

Anechoic Hover Chamber - Hover chamber acoustics and anechoic capability.

Water Tunnel - Water tunnel, low Reynolds Number, low speed tunnel, flow visualization, and force/balance measurements.

Fluid Dynamics Laboratory - Wind tunnel, dynamic stall facility, flow visualization, and interferometry techniques.

Flight Facility - Full-scale rotorcraft/full-scale flight test, airloads, acoustics, and instrumented blades.

UH-60 Black Hawk - Flight control handling qualities, variable stability system, extensive instrumentation, vision aid, and helmet mounted display system.

Computational Capabilities - Engineering analysis, blade element models, flight control law models, stability derivatives and frequency response formats, solution of control inputs for specific maneuvers, wake/performance analysis, acoustics analysis, blade design analysis, rotorcraft performance analysis, finite element structural analysis, rotor and vehicle trim prediction, hover and flight performance codes, stability derivatives, notar and fan-in-fin performance models, and rotary and fixed wing preliminary design (size, weight, drag, propulsion, etc.).

Test Equipment - Vibration and modal analysis, rotor track and balance, vibration diagnostics, and modal property analysis.

Structures:

Structures Lab - Fabrication and test of rotorcraft structures, static, fatigue and vibration testing of full-scale helicopter airframe and rotor blades, composite fabrication machinery, vacuum forming, filament winding, and non-destructive test facility consisting of radiographic, ultrasonic, thermographic, and eddy current tests.

Computational Capability - Aircraft structural analysis, finite element analysis, Computer-Aided Drafting (CAD), crack growth analysis, and planer frame analysis.

U.S. Army Aviation RD&E Center (Continued)

Survivability:

Countermeasures Test Facility - Infrared (IR) countermeasures and counter-detection, IR suppression, indoor and outdoor test ranges, test data recording and analysis, and design and simulation of IR suppressers.

Ballistic Test Range for Aircraft Component Survivability (BTRACS) - Ballistic design criteria and vulnerability evaluation, two outdoor and one indoor fully instrumented test ranges, full-scale aircraft and component testing, fuel recovery systems, and Armor Piercing Incendiary (API) and High Explosive Incendiary (HEI) up to 30 mm in caliber.

Secure Computer Facility - Secure data processing for susceptibility/survivability analysis, RF and IR signature prediction/detect, susceptibility evaluation, air-to-air and air-to-ground mission survivability analysis, and signature and structural analysis.

Computational Capability - Engineering analysis and signature prediction/detection.

Propulsion:

Computational Resources - Analysis of rotary wing engines and transmissions, engine performance analysis, comprehensive mission analysis program (helicopter), finite element structural analysis, heat transfer analysis (steady state), complex chemical composition (combustion), bearing analysis, combustor criteria design validation, shrouded propeller analysis, and transmission weight analysis.

Flight Simulation:

Crew Station R&D Facility (CSRDF) - Fixed-base flight simulator for crewstation R&D (configuration, pilot Helmet Mounted Display (HMD) symbology, and speech input/output command and recognition systems), 3 blue/red team stations, fiberoptic HMD, one or two-seat cockpit, Technical Center can simulate 11 other aircraft, 99 threats, 20 moving targets, and zero feet visibility.

Vertical Motion Simulator with Interchangeable Cabins (VMS/ICABS) - Moving or fixed-base simulator for investigating handling qualities of rotorcraft, Short Take-Off and Landing (STOL) and Vertical Take-Off and Landing (VTOL) aircraft, 4 interchangeable cabins with virtual image TV display, 6 Degrees of Freedom (DOF) motion, acceleration and velocities, sound generation system, and pilot and co-pilot positions.

Rotorcraft Aircrew Systems Concepts Airborne Lab (RASCAL) - In-flight simulator for investigation and validation of advanced control, display and guidance concepts, modified UH-60 aircraft, integrated panel and helmet-mounted displays, full authority fly-by-wire flight controls with mechanical backup, safety pilot, and evaluation pilot cockpits, and RASCAL is fully instrumented.

Flying Laboratory for Integrated Test and Evaluation (FLITE) - In-flight simulator for crewstation and man-machine and engineering investigation, modified AH-15 aircraft, Apache Pilot Night Vision System (PNVS), reconfigurable voice input/output system, flight symbology, and fully integrated instrumentation.

U.S. Army Aviation RD&E Center (Continued)

Helicopter Human Factors Research Facility (HFRF) - Part-task simulator laboratory, four part-task simulators to investigate geographic orientation, visual cues simulator, voice actuated controls, and pilot decision-making.

Aircrew/Aircraft Integration Program (A3I) - Analytic human factors models for conceptual design of rotorcraft crewstations, design/analysis workstation Man-Machine Integration Design and Analysis System (MIDAS) with graphics, integrated human behavior, and performance models.

Display Technology Research Simulators (DTRS) - Facility with various simulators for improving display technologies, ambient lighting simulator, interchangeable cockpits, study adverse lighting effects on displays, part-task simulators.

U.S. Army Aviation RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The AVRDEC has one ORTA person at each of its two remote directorates in addition to its St. Louis facilities. Each of the three ORTA personnel devote only a portion of their time to ORTA functions. The aggregate ORTA effort is the equivalent of 1/2 man-year per year at a cost of approximately \$54 K annually. Additional Domestic Technology Transfer (DTT) activities are performed by Scientists and Engineers, clerical, and legal staff. These efforts are estimated to be at least 1/2 man-year per year and the costs are not separately identifiable as DTT costs.

Publicity:

- * Technology Display and the American Helicopter Society
- * Articles in Army and NASA periodicals
- * Direct contact, by all levels, with industry and academia

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	50	18

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	18	40

Typical Publications and Forums:

- * Aircraft Survivability
- * Army Aviation Association of America
- * Aviation Digest
- * Journal of the American Helicopter Society

Selected Titles:

- * *Cost-Effective Production of Helicopter Energy Absorbing Subfloor Structures with Advanced Thermo-Plastic Composites*
- * *The Applicability of Electrical Drive Accessories for Turboshaft Engines*
- * *AH-64A Apache Helicopter Intelligent Fault Locator*
- * *Ballistic Survivable Army Aircraft Structures Technology Developed at Applied Aviation Technology Directorate (AATD)*
- * *FEDS: The Army's Next Generation Engine Test System*
- * *Systematic Application of Holometric Synthesis for Cost-Effective Flight Load Monitoring*

U.S. Army Aviation RD&E Center (Continued)

CONFERENCES AND SYMPOSIA

<u>CONFERENCES AND SYMPOSIA</u>	<u>FY92</u>	<u>FY93 (through June)</u>
<u>Approximate Number Attended</u>	6	13

Selected Conferences and Symposia:

- * Low Observable Materials Symposium, Fort Eustis, VA
- * The Technical Cooperative Program (TTCP) Aircraft Engine Life Usage Prediction and Condition Monitoring Workshop, Williamsburg, VA
- * Helicopter Military Operations Technology Specialist Meeting (HELMOT V), Williamsburg, VA
- * Annual American Society of Mechanical Engineers (ASME) Gas Turbine Conference, Chairman
- * American Institute of Aeronautics and Astronautics Guidance, Navigation, and Control Conference
- * American Institute of Aeronautics and Astronautics Applied Aerodynamics Conference
- * Annual Forum of the American Helicopter Society
- * Aerotech

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * Polytechnic University - Professors work with AVRDEC researchers to develop items such as the rotor acoustic prediction methodology.
- * Bell Helicopter and Sikorsky - Researchers work on blade design analysis.
- * Boeing Helicopters - Work on computational human engineering tools.
- * University of Tennessee Space Institute - Professors work with AVRDEC researchers to develop rotor hover and forward flight performance codes for distribution to industry.
- * US/Germany Scientist and Engineer Exchange Program

RDT&E CONTRACTS

<u>FY92</u>		<u>FY93</u>	
<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>	<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>
96	\$33.9 M	61	\$29.3 M

Selected Contracts to Commercialize Technology:

- * Second Generation Comprehensive Helicopter Analysis System (2GCHAS) Maintenance & Enhancement Contracts (two contracts)
Commercialization: The development, enhancement, and validation of comprehensive engineering software for rotorcraft analysis and design to enable U.S. manufacturers to develop more capable commercial and military rotorcraft. This contract will enable U.S. industry to increase their competitive edge over foreign helicopter manufacturers who do not have access to such comprehensive analysis software.

U.S. Army Aviation RD&E Center (Continued)

Selected Commercialized Technologies:

- * **Flow Analysis**
Description: Helps in predicting helicopter performance. Sikorsky, McDonnell Douglas Helicopter Corporation, and Bell Helicopters all now have the software.

GRANTS AND COOPERATIVE AGREEMENTS

URI and Centers of Excellence:

	<u>FY92</u>	<u>FY93</u>
* Massachusetts Institute of Technology - Rotor Controls	\$60K	\$60K
* Georgia Institute of Technology - Experimental Model Rotor for Aeroelastic Experiments	\$150K	N/A
* University of Pennsylvania - Continued Development of a JACK 3-D Anthropometric Model	\$30K	\$30K
* Hampton University	N/A	\$60K

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
FY92		FY93	
PHASE I	PHASE II	PHASE I	PHASE II
\$1,169 K	\$5,917 K	\$1,514 K	\$4,821 K

USE OF LABORATORY FACILITIES

Typical Users of the Facilities:

- * Various Companies - Use of experimental aeromechanics facilities on a case-by-case basis.
- * Federal Aviation Administration - Use of flight research aircraft.
- * Boeing - Use of computational facilities under a data exchange agreement.
- * Boeing Helicopters - Conducted ballistic testing of RAH-66 Comanche helicopter drive shafts at the AATD test facility. Level of Effort: 30 man-days.

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
4	10

U.S. Army Aviation RD&E Center (Continued)

Active CRDA's Titles:

- * *Development of a Portable Field Repair System for Composite Aircraft*
Partner: Industry
- * *Ballistic Testing High Performance Armor Components*
Partner: Industry
- * *Mission Planner Technical Assessment*
Partner: Industry
- * *Flight Demonstration of Advanced Digital Flight Control System (ADFCS)*
Partner: Industry

Non-Monetary Contributions:

- * Technical personnel used in the performance of CRDA's
- * Government Furnished Equipment (GFE) aircraft
- * Computer services
- * Use of the AATD's Ballistic Test Range for Aircraft Component Survivability facility for ballistic testing

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
10	6	7	\$37.7 K

Selected Patent Titles:

- * *Multimetal Composite Gear Shaft*
- * *Apparatus for Resin Transfer Molding*
- * *Radial Inflow Particle Separation Method and Apparatus*
- * *Improved Turbine Engine Interstage Seal*
- * *Harness Air Bag Assembly*
- * *Auto Strap Retractor/Tensioner*
- * *Switched Reluctance Generator System with Fault Recovery Capability*
- * *Loss-Compensated Multiplexing Fiber-Optic Sensors*

Selected Patent Application Titles:

- * *SMART-Actuated Rotor System*
- * *A Method for Producing a Blade Deicing or Power Producing System for Rotary Wing Aircraft*
- * *Protective Hardside Covers for Vehicle Surfaces Application*

Number of CRDA's That Provide Trade Secrets: 4

Backlog in Patent Applications: Backlog is due to the workload of patent servicing attorneys at Aviation and Troop Command (ATCOM), St. Louis.

U.S. Army Aviation RD&E Center (Continued)

Attorneys Supporting DTT: There are currently two Attorney Advisers (non-patent attorneys) supporting DTT at AVRDEC. The travel budget is \$3K per year. The attorneys provide periodic training seminars to lab engineers regarding patent application procedures while underscoring the importance of the Army Domestic Technology Transfer agenda.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

The AVRDEC is actively supporting the TRP by providing technical support for the evaluation of the proposals in the Structures and Materials Technology Focus Area. In addition, technical support is provided to evaluate proposals submitted under Broad Agency Announcements (BAA) to ARPA for advanced armor technology programs and to Army Research Laboratory (ARL) for chemical/biological decontamination.

INTERACTIONS WITH NON-DOD ORGANIZATIONS

The AVRDEC makes direct contact with non-DOD organizations at all levels. This is accomplished through Independent Research and Development (IR&D) reviews, technical interchange meetings, data exchange agreements, unofficial cooperative programs, and technical courses which AVRDEC provides. The majority of the interactions are involved in developing and applying rotorcraft aeromechanics, simulation, and man-machine integration technology.

Typical Interactions with Other Government Agencies:

- * Federal Aviation Administration - Joint crashworthiness research programs
- * Drug Enforcement Agency - Advised on and introduced radar for identifying helicopters
- * National Aeronautics and Space Administration - Helicopter crash testing to investigate improved aircrew restraint systems
- * National Aeronautics and Space Administration - Flight test and analysis of rotorcraft long range acoustic propagation
- * National Aeronautics and Space Administration - Support Vertical Take-Off and Landing Effectiveness in Combat Tactical Regimes (VECTR) program by analyzing signatures of several conceptual VTOL designs

Typical Interactions with State and Local Governments:

- * Local Public Schools - Judge Science Fairs

Typical Interactions with Industry: AVRDEC conducts technology interchange with the following industries by technical presentations, program reviews, visits to facilities, and witnessing of testing:

- * Boeing
- * Sikorsky
- * Bell Helicopter
- * Lycoming
- * Smith Industries
- * Brunswick Defense Corporation
- * GE/Garrett
- * Scientific Atlanta
- * McDonnell Douglas Helicopter Corporation

U.S. Army Aviation RD&E Center (Continued)

Typical Interactions with Academia:

- Iowa State - Computational Fluid Dynamics
- Hampton University - Computational Fluid Dynamics
- University of Illinois - Context, Computation, and Complexity: Applications to Aviation Display Design

U.S. Army Aviation RD&E Center (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

The following, listed by topic are our plans for improving the promotion of technology transfer from the AVRDEC.

1. Laboratory Technical Expertise

The AVRDEC now cooperates fully with the Federal Laboratory Consortium (FLC) for Technology Transfer, the National Technology Transfer Center (NTTC), and the Regional Technology Transfer Centers (RTTC's) in establishing databases listing sources for technical expertise. The AVRDEC will focus efforts to increase the number of citations of our Scientists and Engineers in these databases.

2. ORTA

The AVRDEC, being geographically dispersed, has part-time ORTA staff at each of its three locations rather than a single ORTA staffed with one full-time equivalent. Efforts will be made to allocate more resources to DTT efforts, both in man-hours and travel funds, to expand our outreach program and to facilitate training in DTT methods and processes offered by the FLC and others.

3. Conferences and Symposia

The AVRDEC intends to participate in one of the Government/Industry Technology Transfer Conferences, if one is planned that features our broad areas of technology. The AVRDEC also intends to participate in all semi-annual FLC meetings to take advantage of the training and networking opportunities.

4. SBIR

The AVRDEC will afford special consideration to those SBIR projects that exhibit a high degree of commercialization potential. Also, SBIR research topics will be chosen with a view toward dual-use potential.

5. Interactions with Non-DoD Organizations

When invited, the AVRDEC has provided panelists to such events as economic development conferences sponsored by state and local government, technology fairs sponsored by members of Congress, and business development conferences sponsored by academia and others. In the future, the AVRDEC will expand its outreach to publicize our availability for such events.

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ORGANIZATIONAL AREAS OF EXPERTISE

Battlefield Deception - Physical, communication, and electronic (multispectral) deception devices that emulate real equipment. Expertise in visual display techniques, thermal infrared (IR) signatures, radar signatures, and computer controlled radio communications systems.

Bridging - Military tactical bridging systems (assault, support, and Line of Communication (LOC) bridging). Expertise in soil stabilization; organic, graphite epoxy, and thermoplastic composites; structural design techniques; launching techniques; adhesives; structural mechanical joints; automated fabrication and testing; hydraulics; high-strength aluminum alloys; and metal matrix materials.

Construction Equipment - Bulldozers, scoop loaders, compactors, tampers, scrapers, graders, backhoes, cranes, pile drivers, bituminous melters and hot mix plants, water distributors, concrete mixers, paving machines (asphalt), rock crushers and screening plants. Expertise in earthworking, construction, paving and surfacing, quarrying, pneumatic tools, and autonomous/robotics technology.

Countermines Systems - Detection of mines, minefields, and booby traps; neutralization of mines; protective measures; and marking. Expertise in projecting signatures, directed energy, reactive munitions, dispersed explosives, acoustic/seismic, unintentional emissions, x-ray photon, IR, back scatter technologies, short pulse radar, ground penetration radar, high power microwaves, reactive fragments, electromagnetic systems, and wave form generation.

Electrical Power - Electric generators, auxiliary power units (APUs), 1- and 2-man portable generators, vehicle integrated power, and electric drive. Expertise in noise and heat suppression, vehicle in-line generators, high power and energy density pulsed power, small engines, rotating machinery materials, pulse power machinery and transformers, energy storage devices, and microprocessor controls.

Environmental Control - Air conditioners and heaters for field use. Expertise in microclimate cooling equipment, modular heat powered cooling, power generation, space heaters, and refrigerant technology.

Fuel Handling Equipment - Off-shore facilities for super tankers, storage tanks, pumps, filter-separators, testing laboratories, dispensing systems. Expertise in collapsible fuel storage tanks, variable flow rate pumps, tank materials, command and control automated equipment, high pressure hoses, fuel filtration, pipeline components and surveillance, and operation and control.

U.S. Army Belvoir RD&E Center (Continued)

Fuels and Lubricants - All fuels, lubricants, antifreeze, brake fluids, greases, and preventative compounds for ground vehicles. Expertise in long term stability, multipurpose use (e.g., engine oils used in transmission and hydraulic systems), non-flammability, accelerated fuel qualification, lubricants, alternative fuels, preservatives, corrosion, quality monitors, and fuel cleanliness.

Low Cost/Low Observable Multispectral Technology - Multi-spectral materials, lightweight camouflage screens, paints, and coatings. Expertise in near IR and radar signature reduction or attenuation, low emissivity coatings, thermal IR simulation, near IR spectral matching; multispectral coatings and thin films, IR thermal suppression, Ultraviolet (UV), visual and near IR reflectance, and thermal IR emissivity.

Marine Craft - Army Watercraft (e.g., tugs, inland and coastal service and logistic craft, lighters), marine salvage, heavy cranes, harbor service boats, heavy lift lighters, container transfer system, causeways, and soil stabilization techniques. Expertise in marine engineering, high sea state operations, air cushion lighters, cargo transfer during high sea states, and Logistics-Over-the-Shore (LOTS) operations.

Physical Security - Physical measures to safeguard personnel, equipment, facilities, and documents against espionage, sabotage, damage and theft. Expertise in intrusion detection sensors, data processing, alarm displays, assessment, deterrent, response equipment, status monitors, remote data collectors, closed circuit television, entry control, Polyvinylidene Fluoride, and fiber optic cables.

Supply Distribution - Material Handling Equipment (MHE) (robotics-assisted self-deployable forklift trucks, warehouse and all wheel drive forklifts, cranes), Container Handling Equipment (CHE), railway equipment including the Trident II Boxcar, and MILVAN's (containers). Expertise in containerization, movement of supplies, and automated cargo handling.

Support Equipment - Diving equipment, air compressors, industrial gasses, mobile tool sets, and fire fighting.

Topographic equipment - Downsized Direct Support Section (DDSS), Automatic Integrated Survey Instrument (AIS), Position and Azimuth Determining System (PADS), and digital compasses.

Water Supply - 600 and 3000 gallon per hour Reverse Osmosis Water Purification Units (ROWPU). Expertise in production, treatment, cooling, heating, quality evaluation, storage, distribution (collapsible tanks, pumps, hoses, and pipelines), reverse osmosis membranes, and recycle/reuse of water.

UNIQUE FACILITIES AND EQUIPMENT

Anechoic Chamber - A microwave anechoic chamber usable in the VHF to K (100 MHz to 10 GHz) frequency band. The chamber is 22' x 40' x 22' and has a 6' x 6.5' entrance. The chamber is equipped with two Scientific Atlanta azimuth over elevation positioning pedestals and a polar recorder.

Bridge Test Facility - A covered facility to apply static and dynamic cyclic loads up to 200-tons to bridge structures up to 150' long by 40' wide by 20' high. The facility has an acquisition system with 128 channels to monitor and record test data and 90 channels to monitor and record instrumentation data.

U.S. Army Belvoir RD&E Center (Continued)

Climatic Test Chambers - One large chamber for altitude and temperature and two smaller chambers for altitude, temperature and humidity. The large chamber (32' x 14' x 13') has an altitude range of 0-35,000 feet and a temperature range of -80 degrees to +160 degrees Fahrenheit. The smaller chambers (11' x 9' x 9' and 14' x 12' x 9') have a temperature range of -65 degrees to +160 degrees Fahrenheit and a relative humidity range of 35% to 98%.

Fuel and Lubricants Research Facility - This 29,600 square feet facility, in San Antonio, Texas, is staffed by Southwest Research Institute (SwRI) personnel. The facility has numerous labs such as the Petroleum Research and Testing, Analytical Instrumentation, Combustor, Engine, and Bench and also has a large engine test facility and a fuel storage facility. Specialized test equipment for hydraulic fluid, grease, antifreeze, solid film lubricant, and corrosion testing.

Mine Lane Facility - An indoor facility for testing mine detection devices against mines and booby traps. Has six separate lanes, each with a different soil type, and computer data collection capability.

Watercraft Test Facility - A protected freshwater basin (off the Potomac River) for testing shallow draft boats, water craft, and floating bridges. The facility has a launch ramp and a docking pier with fuel, water, and electrical service.

Water Purification Membrane Test Facility - A facility to bench-scale and pilot-scale test water treatment technologies which has access to a large, natural fresh water source.

Shock and Vibration Facility with Rail Hump Test - Full scale shock and vibration testing and full scale rail hump tests with either gondola or box car.

Explosive Test Facility - Ten foot diameter steel sphere for high explosives up to 10 lbs. Equipped with four instrumentation and two viewing ports.

Corrosion Test Facility - For accelerated salt spray testing of mechanical components.

Camouflage Research and Vulnerability Assessment Lab - The radar arch is a horizontal implementation of the Standard NRL radar arch. Measures transmission and bi-static reflection between 4 and 10 GHz.

ASHRAE 16 and ASHRAE 37 Chambers - Testing of environmental control equipment against ASHRAE specifications.

Compressor Calorimeter - Rate output of refrigerant compressors.

Other Instruments - High Performance Liquid Chromatography; reverse osmosis element test stand (2-1/2", 6", and 8" elements); Nuclear Magnetic Resonance Spectrometer; low temperature torque tester; Gas Chromatograph-Mass Spectrometer; Fourier Transform Infrared Spectrophotometer; Portable Oil Spectrographic Analyzer; Pressure Differential Scanning Calorimeter; and High Temperature High Shear Viscometer.

U.S. Army Belvoir RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA is contained within the Industrial Liaison Office at BRDEC. The Industrial Liaison Office had two employees during FY92 and the first quarter of FY93. ORTA/Domestic Technology Transfer (DTT) functions consumed 1/2 man-year per year with a budget of \$56K. During FY93, a Technology Search Team was established. This team consists of technical representatives from the directorates and will devote a total of 1/2 man-year towards ORTA/DDT functions.

Publicity:

- * Listed in the Industry Guide to Federal Laboratories in the Mid-Atlantic Region
- * Listed in the Federal Laboratory and Technical Resources Guide
- * Federal Laboratory Consortium Meetings
- * Government/Industry Technology Transfer Conferences
- * Advanced Planning Briefings for Industry
- * Logistics Exposition
- * NASA Technology 2002 Conference

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	25	2

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	44	37

Typical Publications and Forums:

- * Army RD&A Bulletin
- * Defense and Security Review
- * ENGINEER Professional Bulletin
- * Energy and Fuels
- * Military/Business
- * The Australian Corps of Engineers

Selected Titles:

- * *Polarization Effects on Nearfield Radio Wave Sensing of Buried Anomalies*
- * *Improved Chelators and Sequestrants for Army Water Purification Units*
- * *Predictions of the Radar Cross Section of a Camouflaged Target*
- * *Effect of Low-Lubricity Fuels on Diesel Pumps, Part II - Laboratory Evaluations*
- * *Influence of Particle Size on Sensitivity of Composite Explosives*
- * *Electric Power Parametric Model*

U.S. Army Belvoir RD&E Center (Continued)

CONFERENCES AND SYMPOSIA

Conferences Attended: 54

Selected Conferences and Symposia:

- * Mobility/Counter mobility Modeling and Simulation Symposium, Livermore, CA
- * U.S. Hovercraft Society Winter Meeting, Fort Meyer, MD
- * Joint Oil Analysis Program International Conference, Pensacola, FL
- * International Chlorofluorocarbons (CFC) and Halon Alternatives Conferences, Washington, DC
- * Vehicle Technology Symposium, Dearborn, MI
- * Countersurveillance, Concealment, and Deception Symposium, Fort Walton Beach, FL
- * Fourth Tunnel Detection Symposium on Subsurface Exploration Technology, Golden, CO
- * Ground Target Modeling and Validation Conference, Houghton, MI
- * Army Science Conference
- * Institute of Electrical and Electronic Engineers (IEEE) International Conference on Neural Networks, San Francisco, CA

EXCHANGE PROGRAMS

During FY92 and FY93, BRDEC hosted four scientists and engineers under the International Scientist and Engineer Exchange Program, for one year each. In addition, BRDEC has participated every year in the Army Research Office (ARO)/Battelle Summer Program for University and High School Faculty. Typically, 5-7 educators take advantage of the ARO/Battelle Summer Program each year.

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
250	\$75.9 M	209	\$60.3 M

Selected Contracts to Commercialize Technology:

- * Identification of Biocides for Reverse Osmosis Water Purification Systems - SBIR Contract
Commercialization: Water purification systems
- * Detection of Landmines by Ultra Wideband (Impulse) Radar Array Systems - SBIR Contract
Commercialization: Detection of fuel, water, and power lines buried at various depths
- * Active Noise and Vibration Cancellation for Auxiliary Power Units - SBIR Contract
Commercialization: Quieting auxiliary power units such as refrigeration units on over the road refrigeration vans. Other applications would include quieting most any type of rotating machinery.

U.S. Army Belvoir RD&E Center (Continued)

Selected Commercialized Technologies:

- * **Electrolytic Sterilization of Potable Water**
Description: Uses mixed oxidants to remove the taste of chlorination from disinfected water. Currently being used in some third world communities
- * **Thermoplastic Polymer Matrix Composite Bridge**
Description: Is an advanced composite that has been used to produce a lightweight composite towbar
- * **Water Purification Using Reverse Osmosis Multi-Element Modules**
Description: The modules are now being used to treat, store, and distribute potable water in emergency shelters

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

- * University of Florida - Laboratory Equipment
- * Howard University - Technical and Military Engineering Periodicals

URI and Centers of Excellence:

- * Georgia Tech Research Institute - Materials Metrology Radom and LO Materials Consortium
- * University of Delaware - Infrastructures
- * Virginia Polytechnic Institute and State University, Center of Innovative Technology, and Romem Aqua Systems Company - Failure Analysis of Plastic Reverse Osmosis Multi-Element Module

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
PHASE I	FY92 PHASE II	PHASE I	FY93 PHASE II
\$246 K	\$1,367 K	\$348 K	\$2,596 K

USE OF LABORATORY FACILITIES

Selected Uses of Facilities:

- * 15 Various Companies - Used mine lanes test facility to test and collect data on various techniques for detecting buried mines or other buried objects. Level of Effort: Over 500 testing hours during FY92 and FY93.
- * Filmtec Corporation, Fluid Systems Corporation, and Hydranautic Corporation - Test and evaluation of the reverse osmosis elements and associated equipment from each company.
- * SARRATT Acquisition Management, Inc. - Test and evaluation of SARATT's Soldier Fighting Covers.
- * AM General Corporation - Live fire testing of two High Mobility Multipurpose Wheeled Vehicles (HMMWV).
- * Simuld, Incorporated - Live fire testing of three of Simuld's UH-60 Blackhawk helicopter pilot seats for installation into a standard High Mobility Multipurpose Wheeled Vehicle.

U.S. Army Belvoir RD&E Center (Continued)

COOPERATIVE R&D AGREEMENTS (CRDA)

<u>ACTIVE CRDA's</u>	<u>CRDA's UNDER NEGOTIATION</u>
1	2

Active CRDA's Title:

- * *Evaluation of Non-developmental Compressed Air Foam Systems*
Partner: State Government and Federal Laboratory

Non-Monetary Contributions:

- * Technical personnel
- * Test facilities and equipment

Reasons for Backlog:

- * Lack of personnel

INTELLECTUAL PROPERTY

<u>PATENTS DURING FY92 & FY93 (through June)</u>			
<u>NUMBER ISSUED</u>	<u>NUMBER OF APPLICATIONS</u>	<u>NUMBER OF LICENSES</u>	<u>AMOUNT OF ROYALTIES</u>
3	1	1	N/A

Patent Titles:

- * *3 Color Thermal IR/Visual Camouflage System; 5,077,101*
- * *PVC Support Bracket or Retainer for Grenade Bodies; 4,993,324*
- * *Mine Clearing Rake; 5,198,608*

Patent Application Title:

- * *Mine Clearing Rake*

Number of CRDA's That Provide Trade Secrets: 4

Backlog in Patent Applications: The current backlog includes 21 invention disclosures, several of which may be patentable. The backlog is due to the vacancy of the Patent Attorney position during all of FY 92 and most of FY93. The essential duties of the vacant Patent Attorney position have been performed by Patent Attorneys from other Army Agencies, though they have been unable to devote a significant block of their time to the prosecution of patents. Reduction of the backlog is hoped to be accomplished through the use of temporary details of qualified personnel, use of contract personnel assistance where appropriate, assistance of Patent Attorneys within other Army organizations and/or aggressive recruiting when organizational realignment issues are settled and hiring restrictions are lifted.

U.S. Army Belvoir RD&E Center (Continued)

Attorneys Supporting DTT: There is one Patent Attorney position within the center though it is vacant. Legal office personnel provide advice on Technology Transfer actions including agreements, patents, licenses, and CRDAs. Approximately 1/5th man-year per year has been expended on DDT during FY92 and FY93. Travel expenses are provided by client sponsors.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

BRDEC has spent approximately \$5 K in manpower and resources to support the Advanced Research Projects Agency (ARPA) TRP. These efforts have consisted of discussions between BRDEC Scientists & Engineers (S&E) and industry concerning potential proposals. At least two companies are considering submitting proposals, for which BRDEC may support, to ARPA in response to the TRP.

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * Department of Energy - Alternative Fueled Vehicles
- * Department of Agriculture - Evaluating Fuels, Lubricants, and Associated Products Derived from Agricultural Products
- * Department of Commerce - Desalination and Membrane Separation Research
- * Federal Highway Administration - Infrastructures

Typical Interactions with State and Local Governments:

- * Virginia Center of Innovative Technology - Cooperative Research
- * Fairfax County - Compressed Air Foam System

Typical Interactions with Industry:

- * Society of Automotive Engineers (SAE) - Performance Requirements for Fuels and Lubricants
- * Coordinating Research Council (CRC) - Industry-Government Cooperative Research
- * Martin Marietta - Mine Detection Systems/Sensors
- * Milliken, Inc; Westinghouse; Teledyne-Brown; Brown - Radar Scattering and IR Suppressive Materials

Typical Interactions with Academia:

- * University of Tennessee - Modeling of Camouflage Pattern Effectiveness
- * Johns Hopkins University - Magnetism Research
- * Auburn University - Mine Detection Sensors
- * Pennsylvania State University - Acoustic Sensors and Advanced Digital Signal Processing Techniques

U.S. Army Belvoir RD&E Center (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER

Continue to emphasize Technology Transfer to upper management and S&E personnel. Plans are to provide training on patents to bench level S&E. A course has already been designed and demonstrated on the Center's Technology Search Team.

NOTE: Belvoir Research, Engineering, and Developing Center is now under a Reduction-In-Force (RIF) implementing a Program Management Decision to reduce the workforce by 200 spaces. BRDEC is beginning the process of being dis-established in FY94, with part of the workforce assigned to either Tank Automotive Command or Communications-Electronics Command. Part of the process will be to transfer Technology Transfer control and activities to the respective command.

U.S. ARMY COMMUNICATIONS-ELECTRONICS RD&E CENTER

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ORGANIZATIONAL AREAS OF EXPERTISE

Communications and Space Systems - Improved Combat Net Radio, Antennas, Automated Networking, Survivable Adaptive Systems, Fiber Optics, Distributed Communication & Processing, Global Grid Communications, Extremely High Frequency (EHF) Communications, Integrated Voice, Video, and Data, Wireless Local Area Networks, Frequency Hopping Multiplexing, Multi Band Multi Mode Radio, Satellite Communications, Smart Antennas, Improved Propagation and Spectrum Management, and Modeling and Simulation.

Information Security - Automated COMSEC Management, Network Security Architecture and Protocols, Local Area Network (LAN) Accreditation, and COMSEC non developmental item evaluation.

Command and Control - Command and Control on the move, Combined Arms Command and Control, Interactive Interfaces, Information Management, Situation Awareness (Combat Identification), and Expert Systems Decision Aids.

Night Vision & Electro-Optics/Sensors - Image Processing, Aided Target Recognition, Advanced Focal Plane Arrays, Advanced Optics Development, Advanced Algorithm Exploitation, Multi-Sensor Fusion Algorithms, Diode Pumped Lasers, Second Generation Far Infrared Thermal Imaging (FLIR) development and applications, Infrared Search and Tracking, Thermal Imaging Devices, Image Intensifier Imaging, Detectors and Sensors, Target Acquisition Sensor Fusion, and Optical Avoidance.

Radar - Moving Target Indicator (MTI) Radar, Stationary Target Indicator (STI) Radar, Bi Static Radar, Target Classification, and Intelligence and Electronic Warfare (IEW) Brigade level ground station.

Intelligence/Electronic Warfare - Aircraft and Ground Survivability Equipment, Deception Techniques, Countermeasures, Fratricide Avoidance, Smart Jamming, Extended Frequency Spectrum Coverage, Low Probability of Intercept Signal Detection, Electronic Warfare (EW) Signal Processing New Signals, Signal Exploitation (communication & non-communication), Electronic Warfare Critical Components, Radar/Laser/Infrared (IR) Warning and Countermeasures, IEW Data Fusion, High Speed Signal Processors, Non Cooperative Signal Processors, Neural and Parallel Processing, Artificial Intelligence, Semiconductor Development, Broadband Power Devices, Agile Exciter and Amplifiers, and Efficient High Power Amplifiers.

Position Navigation/Avionics - Aircraft Controls and Displays, Aided Pilotage, Real Time Artificial Intelligence Systems, Navigation, Aviation Communications, and Tactical Data Acquisition and Correlation.

U.S. Army Communications-Electronics RD&E Center (Continued)

Software Technology - Software Process Metrics and Technology, Ada Language, Requirements Engineering, Software Re-engineering, and Software Tools and Methods.

UNIQUE FACILITIES

Space and Terrestrial Communications Directorate (S&TCD) Facilities - Mobile Subscriber Equipment (MSE)/simulation facility; communication security, audio acoustics, and communications research facilities; high frequency channel simulator and fiber optic test facilities; Satellite Communications (SATCOM) control system evaluation facility; tactical and strategic SATCOM evaluation facility.

Command and Control (C2) and Systems Integration Directorate (C2SID) Facilities - System of systems laboratory; artificial intelligence/command and control laboratory; System Testbed for Avionics Research (STAR); navigation and mobile navigation van; flight test profile precision navigation system facilities; integrated avionics hot bench; joint NASA Langley facilities; and aircraft platforms (Huey, Cobra, Blackhawk), avionics shop and hanger facilities.

Night Vision and Electronic Sensors Directorate (NVESD) Facilities - National Center for Special Projects Development; integrated aircraft survivability equipment/armored system modernization hot bench; nuclear radiation test facility; simulation and modeling facilities; infrared countermeasures/laser laboratory; radar cross section measurement facility; focal plane array microfactory and evaluation facilities; forward looking infrared/sensor image evaluation facility; digital/electronic and physical terrain boards; optical countermeasure test and evaluation facility; and secure 5000 m laser range and sensor evaluation test sites.

Intelligence and Electronic Warfare Directorate (IEWD) Facilities - Signals analysis and processing laboratory; electronic countermeasures laboratory; data fusion test facility; IEW simulation and modeling facility; antenna test range; overseas IEW development laboratory; Signals Intelligence (SIGINT) system engineering facility; Improved Guardrail V facility; Common Ground Station high tech R&D facility; meteorological launching facility and special access programs area.

Software Engineering Directorate (SED) Facilities - Army Interoperability Network (AIN) and test bed; MSE interoperability facility; wide area network linking remote sites, contractor facilities and SED; electronic warfare environment simulator; and firmware replication facility.

U.S. Army Communications-Electronics RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The CERDEC ORTA function and Domestic Technology Transfer (DTT) mission falls within the purview of the Domestic Technology Transfer Team of the Advanced Systems Directorate. The team is staffed with six people. In addition to the ORTA at the Headquarters (HQ), each of the five directorates that make up CERDEC has an ORTA focal point that performs technology transfer functions for the directorate. ORTA/DTT functions at the HQ amount to 6 man-years of effort with a budget of approximately 410K. The funding for the ORTA/DTT function is overhead while the funding for the directorate focal points is provided by mission dollars.

Publicity:

- * Federal Laboratory Consortium (FLC) Reference Source
- * Federal Laboratory Consortium Meetings
- * Government/Industry Technology Transfer Conferences
- * Advanced Planning Briefings for Industry
- * Technical Interchange Meetings with Industry (IR&D)
- * CG/CEO Conference
- * Army Technology Base Master Plan
- * Educational Outreach Programs
- * Numerous Briefings at Conferences/Symposium throughout the country
- * CECOM RDEC (Formal widely disseminated RDEC overview)
- * RDEC Lab of the Year Publication

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	20	26

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	119	144

Typical Publications and Forums:

- * Applied Physics
- * Army RD&A Bulletin
- * Institute of Electrical and Electronic Engineers (IEEE) Proceedings
- * Journal of Imaging Science and Technology
- * Optical Engineering

U.S. Army Communications-Electronics RD&E Center (Continued)

Selected Titles:

- * *Propagation Modeling for Tactical Line-of-Sight Communications Links: 'Monthly Climate Factors'*
- * *Current Developments in POSIX Standards and the Ada Run-Time Systems*
- * *Evolving Aircraft Communications Systems Requirements*
- * *Embedded GPS, Considerations for Army Aviation*
- * *Blackhawk Avionics Improvement*
- * *Night Vision and Electro-Optical Imaging Systems*

CONFERENCES AND SYMPOSIA

<u>CONFERENCES AND SYMPOSIA</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Attended	52	48

Selected Conferences and Symposia:

- * Defense Forum, NVESD, Fort Belvoir, VA
- * National Thermogenic Cooler Workshop, Fort Belvoir, VA
- * Horizontal Technology Integration-Industry Meeting, Fort Belvoir, VA
- * Army Technology Opportunities Conference, Baltimore, MD
- * IRIS Infrared Materials and Detectors, San Jose, CA
- * Military Applications of Imaging Technology-Society for Imaging Science and Technology, East Rutherford, NJ
- * Federal Laboratory Consortium, Phoenix, AZ
- * Public Service Recognition Week, Washington, DC

EXCHANGE PROGRAMS

Selected Exchange Program:

- * Summer Faculty Research and Engineering Program

RDT&E CONTRACTS

<u>FY92</u>		<u>FY93</u>	
<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>	<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>
202	\$122.5 M	198	\$110.6 M

Selected Commercialized Technologies:

- * A method for detecting pinholes in hermetic coatings of optical fiber was developed under a SBIR contract and is now being used commercially.

U.S. Army Communications-Electronics RD&E Center (Continued)

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

- * College of William and Mary - Loaned night vision goggles

Investments in University Facilities:

- * North Carolina Agricultural and Technology University - provides funds, monitors, and provides feed back for a Master of Science degree in Software Engineering.

Education Partnerships:

- * Ada Education Initiative at Historically Black Colleges and Universities
- * Growth and Advancement through Education with the Army (GATEWAY)
- * Federal Laboratory Consortium Outreach Program

URI and Centers of Excellence:

- * University of Michigan - High Frequency Microelectronics
- * University of Rochester - Electro-Optics
- * Purdue Universities - Nano-Technology
- * Princeton University - Nano-Technology
- * Clark Atlanta University - 1) Non-Linear Direction Finding Techniques and 2) Generation of Large Intermodulation Interference Free Sets of Communication Frequencies
- * Rutgers University - Ceramic Phase Shifter
- * Currently creating a Center of Excellence on Electronic Imaging, Optics, an Photonics

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
FY92		FY93	
PHASE I	PHASE II	PHASE I	PHASE II
\$1,159 K	\$6,206 K	\$1,505 K	\$8,891 K

USE OF LABORATORY FACILITIES

Various companies use CERDEC's world class facilities such as the Advanced Sensor Evaluation Facility and the Army Interoperability Network. The Advanced Sensor Evaluation Facility is used by Industry to validate and measure the performance of their FLIR systems. The Army Interoperability Network is used to test various communication systems. During FY92, 26 tests were conducted using the Army Interoperability Network with over 151 days of testing.

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
16	4

U.S. Army Communications-Electronics RD&E Center (Continued)

Selected Active CRDA's Titles:

- * *Platform System Integration and Technology*
Partner: Monmouth College
- * *Erbium Glass Laser Technology*
Partner: Varo Incorporated
- * *Commercialization Through Industry/Academia*
Partner: Virginia Center for Innovative Technology
- * *Epitaxial Growth of HgCdTe*
Partner: Loral Vought Systems
- * *Uncooled Thermal Imaging Technology for Medical Sciences*
Partner: Marvin E. Lasser, Inc.
- * *Sensor Fusion of Aided Target Recognition*
Partner: University of Virginia
- * *Development of Photonic and Opto Electronic Devices and Materials*
Partner: Princeton University
- * *Distributive Software, Fiber Optic Systems and Command and Control Visualization System*
Partner: Stevens Institute of Technology
- * *Research and Development on Information Sciences, Communication Systems, and Software Engineering*
Partner: New Jersey Institute of Technology

Non-Monetary Contributions:

- * Personnel
- * Facilities - computers, lab space, and administrative aid

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
30	44	2	N/A

Selected Patent Titles:

- * *Radon Control System; 5,063,624*
- * *Rugged Alpha Particle Counter; 5,059,803*
- * *Non-Dispersive Acoustic Transport Time Delay Beam Steering Antenna; 5,063,390*
- * *Direct Optical Fiber Glass Formation Techniques Using Chemically and/or Physically Removable Filamentary Substrates; 5,114,738*
- * *Radiochromic Dosimeter; 5,120,969*
- * *Method and Apparatus for Producing Enhanced Images of Curved Thermal Objects; 5,138,162*
- * *Anti-Exploitation Method and Apparatus for Controlling Aircraft IFF; 5,223,837*
- * *Method of Making a Flexible Membrane Circuit Tester; 5,062,204*

U.S. Army Communications-Electronics RD&E Center (Continued)

Selected Patent Application Titles:

- * *Thin Film Detector and Method of Fabrication*
- * *Real-Data FFT Buffer*
- * *Focal Plane Array Test Facility*
- * *Method of Establishing Line of Sight Propagation*
- * *Multi-Band Microstrip Antenna*
- * *20 mR Full Scale Carbon Fiber Dosimeter*
- * *Detection and Characterization of LPI Signals*
- * *Abrasion Resistant Diamond Like Coating for Optical Fiber and Method of Forming the Coating*

Backlog in Patent Applications: Currently, there is a backlog of 155 invention disclosures at the Fort Monmouth Legal Office and 107 at Night Vision and Electronic Sensors Directorate (NVESD) Legal Office at Fort Belvoir. The large backlog exists because there are not enough patent attorneys to process the invention disclosures. To supplement the staff, approximately 30-40 invention disclosures per year have been contracted out for the last two years at a total cost of \$180K. Approximately 80-100 invention disclosures per year are received and therefore the backlog has been steadily increasing each year.

Attorneys Supporting DTT: CERDEC's attorney support for Technology Transfer is provided by the Fort Monmouth Legal office and the NVESD Legal Office located at Fort Belvoir. The Fort Monmouth office consists of: one Supervisory Patent Attorney (GM-15); two Patent Attorneys (GS-13) responsible for patent prosecution; two Patent Agents (GS-13 & GS-11) responsible for patent prosecution; and one Patent Attorney (GS-13) responsible for contracts and patent litigation. The cumulative salaries are \$441K and the FY93 travel budget is \$12.6K. The Belvoir office consists of one Supervisory Patent Agent (GM-14), one part time Patent Agent (GS-13), and one Patent Agent (GS-13) with cumulative salaries of \$180K.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

CERDEC has had contact with over 35 different companies concerning possible cooperative agreements for participation in the TRP. The following are some of the technologies being pursued:

- * *Uncooled Thermal Image for Driving Aid*
- * *Ultra Low Cost Family of Night Vision Products*
- * *Domain Analysis and Domain Techniques*
- * *Innovative Software*

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * *National Aeronautical and Space Agency - Advanced Communications Technology Satellite (ACTS) Demo Program*
- * *Department of Justice*
- * *Department of Transportation*
- * *Department of Treasury*
- * *Department of Justice*

U.S. Army Communications-Electronics RD&E Center (Continued)

Typical Interactions with State and Local Governments:

- * Virginia's Center for Innovative Technology - Transfer of federally funded research
- * New Jersey Commission on Science and Technology - Visualization Optics and Software for Command and Control
- * Middle Schools - Science and Technology outreach program

Typical Interactions with Industry:

- * Antenna Products, Inc - Broad Band High Frequency Skywave Antenna
- * International Wire and Cable - Symposium on Cable and Wire Technology
- * Loral Vought Systems Corporation - Close Space Expitaxy Process
- * Marlow Industries - Thermoelectric Materials for Cryogenic Coolers
- * Software Engineering Institute - Domain Analysis for Software Reuse
- * IEEE - Development of a Software Maintenance Standard
- * Small Business Interaction under SBIR Program

Typical Interactions with Academia:

- * Technical Interchange Meetings (TIM) IR&D Reviews
- * Monmouth College
- * University of North Carolina
- * Yale University
- * Rutgers University
- * Princeton University
- * Southern Methodist University
- * Clark University
- * University of Virginia

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

The world of today is significantly different from that of just a few years ago. Today we are in the midst of a world global economy competing for world markets against friends and former enemies alike. The need for our country to remain competitive in this environment however has presented DoD with a unique challenge. That challenge is to meet our defense requirements without the need to maintain separate civilian and military industrial bases, to leverage service programs where possible to meet joint needs in an era of declining resources, and to promulgate the transfer of technology from all available sources to the private sector to stimulate the development and production of new and innovative products for sale in the world market and create jobs.

The CERDEC can contribute to this challenge by emphasizing the dual-use application of technology and by leveraging technology from all available sources. These sources include our traditional defense industries, commercial industry, small business, the other services, academia, and non-DoD federal laboratories. The CERDEC leadership recognizes the challenge and is aggressively pursuing initiatives to meet the challenge.

Specifically, during the coming years the CERDEC will actively pursue its initiative of sponsoring Technical Interchange Meetings (TIM) between Government and Industry to increase the technical information interchange on company sponsored Independent Research and Development (IR&D) within CECOM's business areas of interest. An upcoming CERDEC sponsored TIM conference will focus on Small Business Innovation Research (SBIR) Phase II programs for military and commercial companies to encourage commercialization of these programs or encourage the use of these companies R&D services. Additionally, the Integrated Small Business Innovation Research/Independent Research and Development Pilot Program (I-SIPP) will receive renewed emphasis to match up innovative small business with large companies to bring new innovative dual-use products to the marketplace and help the defense industry diversify into new commercial product lines. Efforts are also underway to better posture the CERDEC to increasingly perform the technology transfer role as Advanced Research Projects Agency (ARPA) agents.

The CERDEC will continue to nurture partnerships with the various sources of technology available and will increase its emphasis on such traditional leveraging programs as IR&D and SBIR. The CERDEC has also institutionalized a broad spectrum of other programs/processes to foster interaction and better working relationships with the private sector. These include Broad Agency Announcements (BAA's); Cooperative Research and Development Agreements (CRDA's); Patent Licensing Agreements (PLA's); the Quick Return on Investment Program (QRIP); and Advanced Planning Briefings for Industry (APBI). The CERDEC also participates in the tri-service Science and Technology Reliance Program, and the Joint Logistics Commanders Forum and Joint Directors of Laboratories.

U.S. ARMY EDGEWOOD RD&E CENTER

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ORGANIZATIONAL AREAS OF EXPERTISE

Physical and Life Sciences - applied to development of chemical/biological agent detectors, protective masks, filter systems for collective protection, decontamination systems, smokes, and obscurants.

Physics - to include aerosol science to predict the behavior of smokes, chemical/biological agents, molecular modeling, fluid dynamics, and wind tunnel testing.

Chemistry - directed toward catalytic air purification, decontamination, toxic/hazardous waste analysis, and remote detection of chemical agents.

Biotechnology - applied to detection of chemical/biological agents (antibody or receptor-based biosensors), enzymatic degradation of chemical agents, and in situ bioremediation of hazardous/toxic wastes.

Toxicology - to include alternatives to live animal testing.

Detection Systems - based on ion mobility and mass spectrometry, laser radar, and passive infrared imaging.

Collective Protection Systems - based on pressure swing adsorption, reactive bed plasma, catalytic oxidation, and improved sorbents.

Chemical Simulants - database.

UNIQUE FACILITIES

(Available for small commercial firms as well as Defense Contractors)

Process Engineering Facility - Dedicated facility for process studies/scale up production of chemical/cellular products; can prove-out laboratory scale processes prior to making critical production base decisions.

Toxic Explosive/Dissemination Chambers - For R&D testing of chemical agents/simulants, prototype equipment, characterization/behavior of aerosols; the only two chambers in U.S./free world to provide state-of-the art filtered toxic agent containment capability for R&D testing of full-scale reaction devices/ munitions.

U.S. Army Edgewood RD&E Center (Continued)

Transonic Wind Tunnel - For research on test items that fly in the transonic speed regime; largest transonic wind tunnel in the Army; can perform functioning/failure tests on components under dynamic conditions.

Vertical Wind Tunnel - To evaluate free flight dynamic motion of submunitions/aerodynamic decelerators/liquid droplets; only vertical wind tunnel within the Army.

Decontamination/Detoxification Facility - To process contaminated material/spent decontaminated material.

Laboratory Test Fixture for Nonrigid Payloads - Allows full-scale artillery payload to undergo simultaneous spinning/coning motion, reflecting actual flight; only flight simulator capable of measuring both spinning/yawing moments associated within nonrigid payloads.

Chemical Transfer Facility - For storage, operation, and ultimate destruction of RD&E chemical agents.

Toxicological Research Complex - An inhalation chamber/animal care facility; for defining chemical hazards to man/environment using animal models; only facility within Army Materiel Command (AMC) for chemical agent testing using animals.

Surety Agent Research Facilities - Fully equipped laboratories with security measures, fume hoods, exhaust filtration units to handle highly toxic compounds; supports all Army chemical/biological defense programs.

Molecular Modeling Facility - Closely networked minicomputers/superstations, combines state-of-the-art graphics, computational power/molecular modeling software; specifically designed for the Army; only facility within the Army with combined high level theoretical computations and graphics capability.

Advanced Protective Systems Integration Laboratory - Contains chambers in which human test subjects can simulate typical battlefield movements; test data provides real-time assessments of protection provided by standard and developmental respirators.

Aerosol Wind Tunnel - Uses articulated mannequins to assess/quantify protection provided by protective overgarments; can measure deposition of aerosol under dynamic flow conditions.

U.S. Army Edgewood RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA at ERDEC consists of one full time person and one person on a part time, as available/needed basis. The ORTA personnel prepare and staff exhibits at trade shows, conferences, etc. and prepare brochures, information papers, and other literature to promote technology transfer. These ORTA efforts cost approximately \$200K per year in salaries and \$13K per year in travel funds, though there is no separate fund set aside specifically to support the ORTA. Technology transfer activities such as the attendance of scientific and engineering personnel at meetings, conferences, symposia, etc. are funded by the directorates to which these personnel are assigned.

Publicity:

- * Technology Transfer Opportunities Brochure
- * Fact Sheets on Individual Technologies
- * Trade Shows/Exhibits
- * Working with Federal Laboratory Consortium and National Technology Transfer Center
- * Member of Northeast Maryland Technology Council

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	184	36

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	85	62

Typical Publications and Forums:

- * Analytical Chemistry
- * Biosensors and Bioelectronics
- * Environmental Pollution
- * Journal of Atmospheric and Terrestrial Physics
- * Journal of the Soil Science Society
- * Science

Selected Titles:

- * *Water Isotherm Measurements for Microparticles of Carbon*
- * *Decontamination of Chemical Warfare Agents*
- * *A Fiber-Optic Immunosensor for Detecting Parathion*
- * *Influence of Trace Additives and Impurities on the Viscoelastic Properties of a Polymer Solution*
- * *Method for Screening and Analysis of Residues Common to Munition Open Burning/Open Detonation Sites*
- * *Detection of Botulinum Toxin Using an Evanescent Wave Immunosensor*

U.S. Army Edgewood RD&E Center (Continued)

CONFERENCES AND SYMPOSIA

Conferences Attended: 63

Selected Conferences and Symposia:

- * 1993 Modeling and Simulation Conference, Aberdeen Proving Ground (APG), MD
- * 1992 Scientific Conference on Chemical Defense Research, APG, MD
- * 1993 Scientific Conference on Obscuration and Smoke/Obscurants Symposium XVII, John Hopkins University, Laurel, MD
- * 17th Annual Army Environmental R&D Symposium, Williamsburg, VA
- * Society for Toxicology Meeting, Seattle, WA
- * 204th American Chemical Society National Meeting, Computational Chemistry Division, Washington, DC
- * 41st American Society of Mass Spectrometry Conference, San Francisco, CA

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * National Research Council Senior Associates
- * National Research Council Junior Associates
- * Summer Faculty Research and Engineering Program (ARO)
- * Short term Science and Technology College Students during the summers
- * Summer Associateship Program for High School Science and Mathematics Faculty
- * U.S. Military Academy Summer Research Program
- * Aberdeen Proving Ground Historically Black College Program
- * Interagency Personnel Agreements (IPA) with seven different Universities

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
36	\$191.8 M	61	\$109.7 M

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

- * Morgan State University - High Performance Liquid Chromatograph System
- * University of Maryland, Baltimore - Thermal Imager

U.S. Army Edgewood RD&E Center (Continued)

Education Partnerships:

- * Clark Atlanta University - Research, development and education
- * Rutgers University - ERDEC scientist is a member of the Advisory Board for the Hazardous Substances Management Research Center
- * Drexel University - ERDEC scientist is adjunct professor and there is an onsite graduate program in chemistry
- * New Mexico State University - ERDEC scientist is adjunct professor
- * University of Texas at San Antonio - ERDEC scientist is adjunct professor
- * Baylor University - ERDEC scientist is adjunct professor

URI and Centers of Excellence:

- * Member of Executive Advisory Board for Toxic Waste Destruction Centers of Excellence Management
- * Member of Executive Advisory Board for Biotechnology for Material Applications Centers of Excellence Management
- * Member of Executive Advisory Board for Biodegradation Center of Excellence Management
- * Member of Technical Advisory Council for Biotechnology for Material Applications Centers of Excellence Management
- * Member of Technical Advisory Council for Biodegradation Center of Excellence Management
- * Member of Technical Advisory Council for Manufacturing Science of Polymer Composites Center of Excellence Management

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
PHASE I	PHASE II	PHASE I	PHASE II
FY92	FY92	FY93	FY93
\$618 K	\$1,062 K	\$407 K	\$1,830 K

USE OF LABORATORY FACILITIES

While there are no agreements that involve company use of ERDEC facilities, at least 32 different on-site contractors use the facilities in the following subject areas:

- * Adsorbent Characterization
- * Biology, Biotechnology, and Antibody Development
- * Trace Analysis
- * Chemistry and Organic Synthesis
- * Miscellaneous Projects

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
2	2

U.S. Army Edgewood RD&E Center (Continued)

Active CRDA's Titles:

- * *Agreement for Feasibility Study Pursuant of Negotiation of Technology Transfer Agreement*
Partner: Industry
- * *Digitation of Chemical Spectra Data*
Partner: Industry

Non-Monetary Contributions:

- * Use of equipment and facilities for test purposes
- * Technical expertise/information

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
31	34	1	\$1 K/year

Selected Patent Titles:

- * *Method and Apparatus for Protecting Crops from Frost by Jet-Dispersed, Microencapsulated Aerosols; 5,052,618*
- * *Method of Measuring the Efficiency of Gas Mask Filters, Respirators and Other Personnel Protective Equipment; 5,080,829*
- * *Short Scan Passive Infrared Remote Sensor; 5,061,854*
- * *Viable Microorganism Detection by Inducted Fluorescence; 5,089,395*
- * *Cell for Measuring Electrical Conductivity and Ion Content of Vapor; 5,097,212*
- * *Compact, High-Energy Auxiliary Power Method and Means; 5,115,633*
- * *Millimeter Wave Screening Cloud and Method; 5,148,173*
- * *Composition of Biologically Pure Cultures on Alcaligens Denitrificans and a Porous Carrier Useful for Biodegradation; 5,169,777*

Selected Patent Application Titles:

- * *Generic Detection with a Receptor Based Fiber Optic Sensor*
- * *Chemical Calibrator*
- * *Heat Sensitive Liquid Chemical Agent and Pesticide Detector and Method of Using*
- * *Comprehensive Identification Scheme for Pathogens*
- * *Lightweight Protective Gas Mask and Hood*
- * *Toxicological Testing Method*
- * *Mueller Matrix Ellipsometer Remote Sensor and Range Finder*
- * *Destruction of Chemical and Biotopical Agents by Means of Induced Radiation*

Backlog in Patent Applications: There is an approximate one year backlog in processing patent applications. The backlog is due to an unfilled patent attorney position during all of FY 93. After several months, an exception to the hiring freeze has been granted and the position will be filled in the near term.

U.S. Army Edgewood RD&E Center (Continued)

Attorneys Supporting DTT: Attorney support for ERDEC is provided through ERDEC's higher command, the Chemical and Biological Defense Agency (CBDA) also located at APG. CBDA has one Patent Paralegal position with patent prosecution/attorney support provided by Picatinny Arsenal. The staff at Picatinny Arsenal handling the intellectual property matters for CBDA consists of three patent attorney positions, including one vacant position. The present salary of the three positions is \$208,934.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

ERDEC has been involved in the TRP and has spent approximately 60 man-hours in discussions regarding what ERDEC would contribute if proposals are funded. Future support may consist of any or all of the following; technical service, use of facilities, and personnel to conduct tests or evaluations.

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * Environmental Protection Agency - Technical assistance with ecological risk assessments and methods for measuring the transport of chemicals in soil
- * Federal Bureau of Investigation - Technical assistance on less-than-lethal compounds and pyrotechnics
- * National Cancer Institute - Structures of chemicals which may have therapeutic value in the treatment of cancer and AIDS
- * State Department & Commerce Department - Technical assistance on chemical export applications
- * Department of Agriculture - Assistance in development of test kits for Botulinum toxin
- * Treasury Department - Work on instrumentation

Typical Interactions with State and Local Governments:

- * State of California, Department of Health - Use of test kits in diagnosis of infantile botulism
- * State of Arkansas, Office for Economic Development and The National Center for Toxicologic Research - Bioprocess manufacturing opportunities and linkage to the National Center for Toxicologic Research
- * States of Maryland, Arkansas, Alabama, Kentucky, Illinois, Indiana, Colorado, Utah, Washington, and Oregon - Modeling for emergency planning and response to chemical releases

Typical Interactions with Industry:

- * Barneby & Sutcliffe Corporation - Evaluation of adsorbents
- * Coutler Electronics - Use of immunological techniques in the flow cytometry of bacteria
- * Electric Power Research Institute - Characterization of smokes and aerosols in the presence of electric fields and ion gases
- * Ethyl Corporation - Toxicological data on synthetic lubricants
- * General Motors Corporation - Dynamic ventilation kinetics
- * Rohm & Haas Company - Evaluation of Adsorbents
- * W.R. Grace, Incorporated - Surface chemistry and Surface Science
- * Xerox Corporation - Computational prototyping

U.S. Army Edgewood RD&E Center (Continued)

Typical Interactions with Academia:

- **University of Pennsylvania Veterinary School - Use of botulism test kits for "Shaking Foal" Syndrome**
- **North Carolina State University, College of Textiles - Measurement of aerosol penetration of textiles**
- **Made invited presentations at numerous universities such as Texas A&M University, Yale University, Duke University, Johns Hopkins University, and University of California-Berkeley**

U.S. Army Edgewood RD&E Center (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

Improving the local technology transfer process will consist of:

1. Office of Research and Technology Applications (ORTA)

No change in the ORTA staff is expected, nor is any change anticipated in the manner in which ORTA/technology transfer activities are funded. Current publications (e.g., brochures, information papers, etc.) will be updated, and a series of new publications will be prepared to promote technologies available for transfer from this center. These will be distributed to representatives of industry, academic institutions, and other government agencies at conferences, trade shows, symposia, etc. The Edgewood RD&E Center will continue to cooperate with the Northeast Maryland Technology council, the State of Maryland, the FLC, and the NTTC to promote technology transfer

This center will participate with the Maryland Department of Economic and Employment Development in the following programs: the Maryland Technology Deployment Network, the Maryland Industrial Partnerships Program for Federal Laboratories, and the Maryland Professional Graduate School Based Federal Technology Transfer Demonstration Project. Also, the Edgewood RDE Center and the University of Maryland Technology Extension Service have initiated an effort to develop a CRDA to provide a mechanism whereby center personnel can directly assist Maryland companies in collaboration with the Technology Extension Service.

2. Technical Reports

The publication of technical reports by this center is expected to continue in a manner and at a level similar to that of previous years. No change is anticipated.

3. Publications

The level of activity associated with publishing articles in scientific, technical, and professional journals is not expected to change significantly. However, with recent revisions of the security classification guides for the release of information concerning defense against chemical and biological warfare, more reports and published articles will become available in the public sector.

4. Conferences and Symposia

The level of participation in conferences and symposia is projected to remain near that of recent years. Many are annual events in which this center participates and/or hosts on a regular basis.

5. Exchange Programs and Visits

These activities are expected to continue next year at or near the reported level. There may be slight fluctuations within specific areas but no appreciable changes are anticipated at this time.

U.S. Army Edgewood RD&E Center (Continued)

6. Contracts

Although contractual efforts are subject to variations in funding, contracts at this center are anticipated to be about the same next year. This is an estimate based on current projections, but is subject to change.

7. Grants and Cooperative Agreements

No changes are anticipated in this area.

8. SBIR

It is expected that this center will continue to participate in this activity at or near the levels of previous years.

9. Use of Laboratory Facilities

Level of activity in this area cannot be projected accurately. Much depends on the establishment of agreements that are being discussed. Concluding several agreements could result in a significant increase in the use of center facilities.

10. CRDAs

Discussions are in progress with several companies to determine the feasibility and benefit of establishing a CRDA. Some of these efforts appear to be quite promising; others have not progressed to a point where a determination can be made. The center will continue to pursue CRDAs to the extent possible. Center exhibits are scheduled to be displayed in several trade shows or in conjunction with scientific conferences.

11. Intellectual Property

Patents issued to personnel at the Edgewood RD&E Center will be assembled into a booklet and distributed to potential partners. Distribution of the booklet will be made at conferences, exhibits, trade shows, etc. Ways to improve the training of scientists and engineers in technology transfer also need to be reviewed and then implemented. In addition, the patent process within this center will be examined and modified, if necessary, to make the process more efficient.

12. Technology Reinvestment Project (TRP) Efforts

The projected level of activity in this area is unknown, and is subject to the selection and funding of proposals in which this center is designated as a partner. The center will continue to support and participate in this project where appropriate.

13. Interactions with Non-DoD Organizations

No changes are anticipated in this area. This center will cooperate with any non-DoD organization that expresses an interest in our areas of expertise.

U.S. ARMY MISSILE COMMAND RD&E CENTER

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ORGANIZATIONAL AREAS OF EXPERTISE

Provide life cycle system engineering, production engineering, and execute management of computer resources embedded in battlefield in the areas of system, design, production engineering and tactical.

Provide scientific, engineering, and technical support for all weapons system program life cycle phases.

Perform development engineering for missile systems.

Plan, develop, and manage product assurance programs for command materiel including ammunition.

Perform research in technology and methodology for improving the effectiveness of product assurance programs.

Provide simulation to support exploratory, advanced, and engineering development programs.

Develop concepts and maintain long-range plans for weapon system acquisition and supporting research and development.

Perform feasibility and design studies and prepare specifications for future weapon systems.

Design, develop, and fabricate prototype missile systems components.

Assure U.S. Army Missile Command is a smart buyer of missile weapon system.

Provide technical support to U.S. Army Missile System project managers.

Provide technical input to military planning.

Provide technical corporate memory for U.S. Army Missile Systems and missile technology.

Provide independent product assessment.

Serve as a stimulus to industry and universities.

Transfer government developed technology to U.S. industry and promote dual use technology utilization.

Provide foundations for multi-spectral missile systems, insensitive, high performance, minimum signature propulsion systems, air defense target acquisition systems, and missile aerodynamics and structures.

U.S. Army Missile Command RD&E Center (Continued)

UNIQUE FACILITIES

Propellant Mechanical Properties Facility - Completed in 1988, dedicated to solid rocket motor structural integrity and service life extension investigation.

Anechoic RF Test Chamber - Renowned for its unique capability for realistic simulation of surface wave propagation due to wide anechoic band-width and physical size with a specially designed floor.

Target and Seeker Measurement Facility - Is used for sensor/seeker design measurements. It includes a 300 foot tower and target turntable combination allowing operator access to equipment at any elevation up to the maximum and viewing of target at any aspect.

Army Missile Optical Range - Used extensively for measurement of Strategic Defense Targets with its one of a kind 2 meter aperture, compact laser range capable of illuminating large targets, under simulated far field conditions, at short range.

Advanced Simulation Center - Provides Hardware-in-the-Loop Simulation across the electromagnetic spectrum.

Fire Support System Integration Lab - Is equipped with end to end weapon system hardware check out design. Contains distributed, netted communication nodes to perform high and low level system tests and is currently configured to check out the Multiple Launch Rocket System (MLRS) family of munitions.

Guidance and Control Analysis Facility - Is an all digital facility for check out of flight systems, this capability is unprecedented in its system bandwidth. Currently used for real time check out of extremely high bandwidth and Advanced Kinetic Energy Missile (ADKEM) guidance and control components.

UAV System Integration Laboratory World - Is unique in its ability to integrate multiple Unmanned Aerial Vehicle (UAV) systems and test common subsystem integration interfaces.

Propellant Signature Characterization Facility - Is the most complete plume signature characterization facility in the U.S. and includes infrared, visible, and radar capability.

Automated Manufacturing Cells - Contains a uniquely automated, fiber optic winding capability and a cell for automated inspection of printed circuit boards down to 1-2 mils line width.

Laser Induced Chemistry Facility - Includes lasers covering ultraviolet to infrared and analytical instrumentation to identify compounds resulting from laser induced reactions.

Air Defense Interoperability Test Facility - Designed for weapon system software check out, this is the only facility in the U.S. Government having, in residence, all Army deployed tactical air defense systems (Patriot, AN/TSQ-73, Hawk with radar) and regularly conducts inter-service and intra-Army testing.

Composites Manufacturing Facility - Is a principal Government repository of technical expertise in this area, this facility provides MRDEC engineers with "hands on" capability in missile composites manufacturing from project concept, through fabrication, and testing.

U.S. Army Missile Command RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA is located in the Technology Integration Office (TINTO), which is a special staff office supporting the Director of MRDEC. The ORTA has one full time and one part time employee and is augmented by the TINTO as required. Additionally, the ORTA's \$90K budget provides a limited amount of contracted technical assistance. Each year, the ORTA executes approximately four man-years of effort.

Publicity:

- * Technology Transfer Committee with the Huntsville Chamber of Commerce
- * Virtual Reality Consortium - interviews local businesses to determine technology transfer opportunities
- * Electronic Catalog of Potential Dual Use Technologies
- * Member of the Governor's Council on Technology and Aerospace
- * Work with Alabama's Economic Development Centers
- * Work with the Federal Laboratory Consortium (FLC) and the National Technology Transfer Center (NTTC)

TECHNICAL REPORTS

TECHNICAL REPORTS	FY92	FY93 (through June)
Submitted to DTIC	133	75

PUBLICATIONS

PUBLICATIONS	FY92	FY93 (through June)
Approximate Number Published	77	55

Typical Publications and Forums:

- * Institute of Electrical and Electronic Engineers (IEEE) Journal of Quantum Electronics
- * Journal of American Chemical Society
- * Journal of Applied Physics
- * Journal Neural Networks
- * Optical Engineering
- * Signal and Image Processing

Selected Titles:

- * *White-Light Optical Fourier Transform Device*
- * *Sonic Band Structure in Fluids with Periodic Density Variations*
- * *Automatic Selection of Correlation Filters Using Expert Networks*
- * *Near Dipole-Dipole Interaction Effects in Nonlinear and Quantum Optics*
- * *A Gaussian Measure of Quantum Phase Noise*
- * *Anti-Stokes Generation and Soliton Decay in Stimulated Raman Scattering*

U.S. Army Missile Command RD&E Center (Continued)

CONFERENCES AND SYMPOSIA

Conferences Attended: 65

Selected Conferences and Symposia:

- * 29th American Institute of Aeronautics and Astronautics (AIAA) Joint Propulsion Conference, Monterey, CA
- * 1992 American Society of Mechanical Engineers, Winter Annual Conference, Anaheim, CA
- * 1993 Automotive Technology EXPO, Dearborn, MI
- * 1992 Spring Meeting of the Materials Research Society, San Francisco, CA
- * 1992 Annual Meeting of the Optical Society of America, Albuquerque, NM
- * 1992 Advanced Microelectronics Technology, Reliability, and Logistics Workshop, San Jose, CA
- * 1992 Defense Manufacturing Conference, Atlanta, GA

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * Department of Defense Science and Engineering Apprentice Program
- * Summer Faculty Research and Engineering Program
- * National Research Council Resident Research Associateship Program
- * Intellectual Property Agreement - University of Southern California - San Diego
- * High School Science and Mathematics Faculty Program
- * College Apprentice Program

RDT&E CONTRACTS

MRDEC had 200 active RDT&E contracts during FY93 with a total value of \$300 million.

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

- * Oakwood College - Loaned a Laser System
- * Georgia Institute of Technology - Infrared Solder Inspection System
- * University of North Carolina - Loaned a Laser System
- * University of Alabama at Huntsville - Electronic Equipment

U.S. Army Missile Command RD&E Center (Continued)

Education Partnerships:

- * Georgia Institute of Technology
- * University of North Carolina
- * University of Alabama at Huntsville
- * Mercer University
- * Clark Atlanta University
- * Alabama A&M
- * Oakwood College
- * Athens State College
- * Troy State College
- * Drake Technical

URI and Centers of Excellence:

- * Georgia Institute of Technology's Center for Excellence for Engineering Data Exchange
- * Hughes Missile Systems Corporation's National Optical Coating Critical Technology Center

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
PHASE I	FY92 PHASE II	PHASE I	FY93 PHASE II
\$397 K	\$2,889 K	\$1,045 K	\$3,310 K

USE OF LABORATORY FACILITIES

Selected Use of Facilities:

- * Magnetek - Performed a material analysis and study of mechanical components of Magnetek electrical motors to determine the cause of a recurring problem with the motors. Level of Effort: 50 man days.
- * Various Companies - Use of virtual reality simulators. Level of Effort: 60 days/year.
- * Various Companies - Use test facilities.

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
2	8

Active CRDA's Titles:

- * *Multi-Target Tracking System*
Partner: Industry
- * *Development of Missile Systems Related to Manufacturing Processes, Equipment and Software Tools*
Partner: Academia

U.S. Army Missile Command RD&E Center (Continued)

Reasons for Backlog: There is not a backlog of CRDA's.

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
31	18	N/A	N/A

Selected Patent Titles:

- * *Fast Optical Switch and Limiter Using Quantum Size Effect in Metal Grain Composites; 5,059,003*
- * *Device for Applying Adhesive onto Fiber and Drying Before Winding; 5,060,593*
- * *Countertriangular Optical Position Sensor; 5,078,333*
- * *Integrally Wound Joint Structure; 5,227,208*
- * *Electronic Triple Point Cell; 5,219,225*
- * *Solid Stripper for a Space Based Neutral Particle Beam System; 5,177,358*
- * *Spark Map for a Resistive Material Using Magnetic Field Detection; 5,155,438*
- * *FM Video Data Link Spectrum Spreading; 5,140,610*

Selected Patent Application Titles:

- * *Infrared Image Projector Utilizing a Deformable Mirror Device Spatial Light Modulator*
- * *High Resolution Video Acquisition System*
- * *Compensation for Black Hole Effect in Thermal Sensors*
- * *High Precision Transfer Lamination Mandrel*
- * *Optical Waveguides in Electro-optical Polymers and Method*
- * *Method to Extract and Recover Nitramine Oxidizers from Solid Propellants Using Liquid Ammonia*
- * *Coaxial Engine for Ducted, Hybrid, and Gel Bi-propulsion Systems*
- * *Ultraviolet Fluorescence Spectrographic Analyzer*

Backlog in Patent Applications: There is currently a backlog of 85 invention disclosures for which patent applications have not been filed. The backlog is due to a reduction in the staff of the MICOM Legal Office and an increase in the rate of disclosure submissions. The professional staff was reduced from 10 to 6 persons in the last four years and the support staff was reduced from 7 to 2 persons in the last two years. The positions were vacated due to retirements and transfers, could not be filled due to the hiring freeze, and most were lost in a recent reduction in force.

Attorneys Supporting DTT: Legal support for the MRDEC is provided by the MICOM Legal Office who also supports other Army elements co-located at Redstone Arsenal. The MICOM Legal Office has a total of four patent attorneys and two patent advisors to provide support for procurement matters, patent disputes, claims, and DTT matters. The grade structure for the professional staff consists of one GM-15, four GS-14's, and one GS-13. Out of the four patent attorneys, only one patent attorney provides direct support on DTT matters to the MRDEC and the other co-located Army elements.

U.S. Army Missile Command RD&E Center (Continued)

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

The MRDEC has invested about 1618 man-hours in pursuit of TRP efforts. Efforts included reviewing initial academia and industrial proposals submitted to the Advanced Research Project Agency (ARPA), establishing contacts with sponsors of those proposals holding the most promise for exploiting MRDEC capabilities, and developing CRDAs to document resulting agreements. The MRDEC received 14 proposals and supported 12. Examples of those supported are listed below:

- * SPARTA, Incorporated - Establish an Optoelectronics Center to develop Applications of Photonic Bandgap Structures.
- * University of Alabama at Huntsville - Form a Southeast United States Industrial Alliance for Electronics Assembly to promote development of new packaging technologies.
- * Litton Data Systems - Establish a bilateral collaboration agreement on developing Optical Processing Technologies.
- * Millipore Corporation - Establish a Health Care Technology Development initiative called the Optical Bioanalyzer Consortium.
- * Manufacturing Research Center - Establish an Electronics Consortium to develop manufacturing technologies for assured high quality, affordable electronics assemblies. This consortium will initially focus on problems in the automotive industry.
- * Hughes Missile Systems Corporation - Establish a National Optical Coating Critical Technology Center of Excellence involving academia, industry, and the Federal Government.

INTERACTIONS WITH NON DOD ORGANIZATIONS

The MRDEC is part of a joint technology transition project currently being formed which is entitled the "Next Generation Multi-Chip Module (MCM) Automotive Engine Controller". The purpose of this proposed industry/government/university alliance is to accelerate the development of MCMs high volume, low cost electronics manufacturing for use by both industry and Government. The other participants are:

- * Harris Government Communications Systems Division
- * Chrysler Corporation - Huntsville Division
- * Auburn University
- * Georgia Institute of Technology - Georgia Tech Research Institute
- * Rome Air Development Center

Typical Interactions with Other Government Agencies:

- * National Aeronautical and Space Administration - Developing the reliability assessment of alternative technologies for the elimination of Class I ozone depleting chemicals used in the cleaning of DoD related electronic assemblies.
- * Department of Energy, Oakridge, TN
- * U.S. Postal Service - Technology base and potential applications
- * Department of Commerce, National Institute for Standards and Technology - Technical reviews on specific manufacturing technology
- * Department of State - Microwave and millimeterwave integrated circuits (MIMIC) export licenses

Typical Interactions with State and Local Governments:

- * Huntsville Chamber of Commerce
- * Alabama Department of Economic and Community Affairs of the Governor's Office

U.S. Army Missile Command RD&E Center (Continued)

Typical Interactions with Industry: Contact with numerous companies through interchanges at various technology and manufacturing technology workshops/conferences/symposia. Working with more than 30 companies within Alabama through the Virtual Reality Consortium that MRDEC initiated to facilitate DTT. Typical participants include:

- * UNISYS
- * Raytheon
- * Lockheed
- * TRW
- * SPARTA
- * Nichols Research Corporation
- * Quality Research

Typical Interactions with Academia:

- * Florida Institute of Technology
- * Georgia Institute of Technology
- * Purdue University
- * Syracuse University
- * University of Alabama
- * University of Michigan
- * University of North Carolina
- * Virginia Polytechnic Institute and State University

U.S. Army Missile Command RD&E Center (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

In 1994, the U.S. Army MRDEC will improve its technology transfer program by emphasizing marketing and licensing while solidifying the existing Cooperative Research and Development Agreement (CRDA) process.

Specific Plans

1. Finalization of a local supplement to AR 70-57, which has been approved by Headquarters, Department of the Army. This local supplement will contain three model cooperative research and development agreements: (1) A long-form for large projects; (2) A short-form for simple transfers of material or information to non-Government parties; and (3) A material transfer model for transfer of non-commercial material or information to the Government for testing. Final issuance of this supplement will solidify the program by providing a minimal uniform system throughout the Command without curtailing flexibility.
2. Training of all scientists within the Command on basic intellectual property law, the technology transfer process, and ethics issues unique to technology transfer.
3. Detailed training of ORTAs on commonly negotiated provisions of CRDAs.
4. Establishment of a multi-discipline invention review committee to prioritize invention disclosures and identify inventions for early marketing efforts.
5. Begin to computerize the patent docketing system for the command which will again aid in marketing efforts.

U.S. ARMY NATICK RD&E CENTER

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ORGANIZATIONAL AREAS OF EXPERTISE

Soldier as a System Management - Individual warrior equipment to maximize individual survivability, sustainability, and combat effectiveness including modeling and simulation of survivability, performance, and combat effectiveness.

Food Science and Technology - DoD agent for ration development, food packaging, food service equipment and supporting technology base.

Clothing and Textile Technology - Individual protective equipment, laser protective equipment, percutaneous chemical/biological protection, ballistic protection, other individual soldier items and dress clothing.

Airdrop - Parachutes and airdrop platforms and systems.

Biotechnology for Advanced Materials - Includes biodegradable packaging, fibers and other polymers.

Behavior/Performance - Individual acceptance, performance measurement, biomechanics of individual equipment.

Shelter Design and Development - Tentage and rigid wall shelters.

UNIQUE FACILITIES AND EQUIPMENT

Climatic Chambers for simulating worldwide environments, such as tropic and arctic conditions (-70 to 165°F with 10 to 90% humidity, wind 2 to 40 MPH and solar load).

Clothing and Textile Prototyping and Testing for development of new uniforms, helmets and boots, including wear, durability, dye, finishing, and other testing.

Food Processing Pilot Plant for ration development, food service equipment, and food processing technologies.

Computerized Clothing Pattern Processing System for generating a set of patterns in all sizes and lengths.

U.S. Army Natick RD&E Center (Continued)

Drop Test Facility for simulating loads dropped from aircraft.

Helicopter Dynamic Load Simulation Facility for verification of helicopter rigging procedures and to simulate lifting/pulling of transport loads.

Instrumented Mannequin for thermal studies on uniform systems and field tests.

Microbial Laboratory for identification of food pathogens and spoilage organisms.

Rain Simulator Tower for simulating fabric testing outdoors.

Ultra Fast (Picosecond) Laser Facility for materials evaluation.

U.S. Army Natick RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA is organizationally under the Advanced Systems Directorate at NRDEC. During FY92 and FY93, ORTA/Defense Technology Transfer (DTT) functions consumed about 0.4 man-years of effort at a cost of \$18.8K. Besides the DTT Program, the ORTA also handles the SBIR, MTCL, and ILIR Programs.

Publicity:

- * Dual-Use Technologies Publication
- * Information for Industry Program
- * Fact Sheets
- * Natick Pocket Guide

TECHNICAL REPORTS

TECHNICAL REPORTS	FY92	FY93 (through June)
Submitted to DTIC	40	17

PUBLICATIONS

PUBLICATIONS	FY92	FY93 (through June)
Approximate Number Published	90	83

Typical Publications and Forums:

- * Journal of Applied Physics
- * Journal of Colloid and Interface Science
- * Journal of Food Science
- * Journal of Molecular Crystals and Liquid Crystals
- * Journal of the American Dietetic Society
- * Textile Research Journal

Selected Titles:

- * *Turbulent Effects on the Aerodynamics of Parachutes*
- * *T Ration and MRE Soldier Enhancement*
- * *Detection and Control of Cold Tolerant Pathogens in Chilled Foods*
- * *Blown Film from Starch/Poly (Vinyl Alcohol) and Starch/Ethylene-Vinyl Alcohol Blends*
- * *Fundamentals of Biodegradable Polymers*
- * *The Effects of Various Thicknesses of Chemical Protective Gloves on Manual Dexterity*

U.S. Army Natick RD&E Center (Continued)

CONFERENCES AND SYMPOSIA

<u>CONFERENCES AND SYMPOSIA</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Attended	88	32

Selected Conferences and Symposia:

- * 39th Sagamore Army Materials Research Conference on the Science and Technology of Fire Resistant Materials, Plymouth, MA
- * Laser Hardened Materials Structures Group Meeting, Washington, DC
- * National Association of Uniform Manufacturer and Distributors, Palm Springs, FL
- * Institute of Food Technologist National Meeting, New Orleans, LA
- * 1993 Society of Plastics Engineering Annual Technical Conference, New Orleans, LA
- * 17th Annual Meeting Technology Transfer Society, Atlanta, GA
- * American Society of Mechanical Engineers, Atlanta GA
- * International Conference on Antioxidants, Tarrytown, NY

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * Summer Faculty Research and Engineering Program - Northeastern Ohio University, School of Medicine
- * Short Term Analysis Service - Worcester Polytechnic Institute, Harvard University, and Massachusetts Institute of Technology
- * Polaroid Corporation
- * Battelle-Columbus
- * University of California, Davis
- * Princeton University
- * Optical Coating Laboratory, Inc.
- * University of Massachusetts, Boston

RDT&E CONTRACTS

<u>FY92</u>		<u>FY93</u>	
<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>	<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>
190	\$32.0 M	117	\$14.1 M

Selected Contracts to Commercialize Technology:

- * A SBIR contract with Arcanum and a contract with Fiber Materials are ongoing with the intent of commercializing super-activated carbon technology in the U.S.
- * The Individual Microclimate Cooling Technology developed under contract with Foster-Miller, is planned to be commercialized
- * A waterproof/breathable, solvent-phobic membrane technology developed under contract with Tempo-Shain, is planned to be commercialized by Tempo-Shain

U.S. Army Natick RD&E Center (Continued)

Selected Commercialized Technologies:

- * Kevlar KM2-based materials are being sold commercially by I.E. DuPont, for civilian body armor
- * Spectra-based materials are being sold commercially by Allied-Signal, for civilian body armor
- * A radar absorbing fabric developed by Millimeter Wave Technology under a SBIR program is being used by several other defense contractors for various applications

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

- * University of Rhode Island - Rolcon Ultra Filtration Unit
- * Rutgers University - Spray Dryer, Fluidized Bed Agglomerator, and Vacuum Cooker
- * University of Georgia - Meat Emulsifier and Vacuum Cooker

Education Partnerships:

- * Textile Technology Center of Excellence

URI and Centers of Excellence:

- * Drexel University, Temple University, and Philadelphia College of Textiles and Science - Established the Textile Technology Center of Excellence
- * Northeastern University - Center for Electromagnetics Research

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
PHASE I	FY92 PHASE II	PHASE I	FY93 PHASE II
\$340 K	\$1,627 K	\$1,025 K	\$2,622 K

USE OF LABORATORY FACILITIES

There are many instances in which NRDEC tests and evaluates material for Industry, normally benefiting both the company and the Government. A specific example is the utilization of NRDEC's single yarn impact test as a first approximation of potential to full ballistic evaluation of materials. There are no formal agreements established between NRDEC and Industry for the use of NRDEC's textile facilities solely for commercial applications.

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
11	11

U.S. Army Natick RD&E Center (Continued)

Selected Active CRDA's Titles:

- * *Development of Biogenetically Engineered Spider Silk*
Partner: Monsanto
- * *Biodegradable Plastics for Packaging*
Partner: Warner-Lambert
- * *Radiation Preservation of Foods*
Partner: Vindicator
- * *Optimization of Polyfibers for Body Armor Application*
Partner: Michigan Molecular Institute
- * *Development of Biodegradable Products*
Partner: Rohm and Haas
- * *Shelf Stable Breads and Bakery Products*
Partner: Milo Bakeries
- * *Listeria Detection Apparatus*
Partner: Vicam, Limited
- * *Microencapsulation of Performance Modifying Nutrients*
Partner: BioMolecular Products, Incorporated

Non-Monetary Contributions:

- * Personnel expertise
- * Facility and equipment

Reasons for Backlog: Due to a continuous streamlining of the CRDA process, there is not a backlog, however there is a heavy workload of potential CRDA's due to a limited number of persons processing CRDAs.

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
8	10	2	\$5 K

Selected Patent Titles:

- * *Enzyme Detergent Formulation and Methods of Detoxifying Toxic Organophosphorous Acid Compounds; 5,169,554*
- * *Method for Synthesizing an Enzyme-Catalyzed Polymerized Monolayer; 5,143,828*
- * *Leavened Breads with Extended Shelf Life; 5,059,432*
- * *Quick Release Buckle Assembly; 5,205,021*
- * *Combustion Chamber for Multi-Fuel Fired Ovens and Griddles; 5,096,412*
- * *Radial Reefing Means for Use in Packing and Opening a Parachute Canopy in a Controlled Manner; 5,209,436*
- * *Synergistic Effect of Amylopectin-Permethrin in Combination on Textile Fabrics; 5,089,298*
- * *Self Heating Individual Meal Module; 5,220,909*

U.S. Army Natick RD&E Center (Continued)

Selected Patent Application Subjects:

- * Biodegradable Materials
- * Biotechnology
- * Clothing
- * Color Matching Method
- * Cooling Vest
- * Food
- * Infrared Signature Reduction
- * Photo-Electronic Film

Number of CRDA's That Provide Trade Secrets: 11

Backlog in Patent Applications: There is currently not a backlog.

Attorneys Supporting DTT: Support is provided by one attorney at the GS-14 level. Additional Intellectual Property Attorney support will be required in the future due to the increase in requests for CRDAs and upcoming major revisions in the laws related to data rights in Government contracts. There is not a specific travel budget for DTT activities.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

NRDEC has urged and encouraged industrial organizations to submit proposals in areas of potential benefit. NRDEC has talked directly with four companies, with representatives of two others, and two universities. NRDEC is prepared to provide Advanced Research Projects Agency (ARPA) its expertise in the proposal evaluation and subsequent execution of the program in the following areas:

- * Biotechnology/Environmental Technology
- * Food Science/Nutrition
- * Heads-Up Display Technology
- * Materials/Structures Manufacturing
- * Textile Technology

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * Bureau of Engraving and Printing
- * Department of Commerce - National Institute for Standards and Technology
- * Department of Energy
- * Department of Justice
- * Department of State
- * Federal Emergency Management Program
- * Food and Drug Administration
- * Forest Service

Typical Interactions with State and Local Governments:

- * Numerous State and Local Police - Ballistic Protective Materials

U.S. Army Natick RD&E Center (Continued)

Typical Interactions with Industry:

- * Foundation Technologies
- * Gentex
- * Gerber Garment Technology, Inc.
- * Hughes Aircraft
- * Martin Marietta
- * Monell Chemical Senses
- * Ocean Spray Cranberries
- * Reebok

Typical Interactions with Academia:

- * Boston University
- * Clemson University
- * Cornell University
- * Illinois Institute of Technology
- * Tulane University
- * University of Hawaii
- * University of Washington
- * Virginia State University

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

In order to improve the NRDEC Domestic Technology Transfer Program we will analyze our current Technology Transfer activities. We will be looking at the direction of our program, review all technologies for transfer potential, develop a data base to help identify and track Technology Transfer (TT), investigate the possibility of all new opportunities, identify any deficiencies or gaps and identify particular successes for application to other areas. From our analysis we will develop a robust plan to capitalize on our success and to push NRDEC technologies into the commercial arena.

Aspects of FY94 Domestic Technology Transfer Program will include:

1. Complete Program Analysis

An in-depth analysis of all TT subprograms will be made to streamline the development of Cooperative Research and Development Agreements, Patent License Agreements, and responding to technical requests from industry, academia and state and local government.

We will review and investigate all NRDEC technology areas to determine what NRDEC technologies have potential commercial value. Make recommendations for methods to increase technology transfer of the most promising technologies and recommendations for potential patentable areas. The technology areas include but are not limited to those technologies involved in: food, food service equipment, food packaging, shelters, tentage, field service equipment, airdrop, textiles, clothing, and individual equipment.

2. Unique Facilities and Equipment

NRDEC has an extensive amount of unique equipment and facilities due to our broad range of technical areas. We will identify these unique pieces of equipment, facilities, or capabilities that have potential value or potential for cooperation with industry, specifically small local companies unable to obtain/use this type of equipment. Identify and develop methods or means to share these assets and explore cooperative advantages in such cases.

3. Technology Data Base

We plan to develop and implement a NRDEC wide method for organized tracking of all technology transfer activities including technology inventory, commercial application screening, market assessment, and identification marketing outreach follow-up of expressions of interest and final results.

4. Training

A cultural change must take place from a certain mind set in which research focused purely on military needs to research geared on dual-use, commercialization, and defense conversion. We will formulate plans, based on the above findings, for providing tailored training to appropriate target audiences at NRDEC in specific topics, emerging trends, and other subjects for this training. Training requirements and emphasis will differ by group, i.e., supervisors, managers, staff support, project officers, and others.

U.S. Army Natick RD&E Center (Continued)

5. Marketing and Outreach

We will develop a capabilities video that highlights unique facilities, equipment, and services. This video, scheduled to be completed 2QFY94, has potential to highlight CRDA possibility or other cooperative endeavors.

We will be marketing NRDEC technologies and capabilities via participation in Advanced Planning Briefings with Industry (APBI), numerous conferences, and trade shows. We will continue to emphasize publication in all types of technical, trade, and special interest publications.

6. CRDAs and Patents

As an increasing number of patents are developed, we will review each one for commercialization potential. Those NRDEC patents with commercialization potential will be publicized in the Federal Register for licensing. All of our marketing and outreach activities will emphasize potential for cooperative endeavors with NRDEC.

U.S. ARMY RESEARCH LABORATORY

ORTA: Mr. R. Michael Claffy
U.S. Army Research Laboratory
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Adelphi, MD 20783-1145

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FAX: (301) 394-5818
DSN: 290-3098
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ORGANIZATIONAL AREAS OF EXPERTISE

High performance computing; advanced computer architectures; software and simulation technology, and artificial intelligence.

Aerosol physics and atmospheric effects research.

Nanoelectronics/optoelectronics/photonics; microwave/millimeter-wave devices; optical devices/focal plane arrays; power sources/pulsed power; and accousto/ferroelectronics.

Human factors engineering.

Materials science and technology; elastomers and coatings; processing science/manufacturing technology; and corrosion prevention/control.

Sensor technology; digital/optical signal processing; signatures; and information fusion/processing.

Survivability/lethality/vulnerability analysis and electronic warfare.

Gas turbine and reciprocating engine technology such as gears, bearings, and seals; engine control systems; and power transfer systems.

Rotorcraft aerodynamics; vehicle structures; and structural analysis and dynamics.

Advanced projectile and propulsion concepts; flight physics; low observable technology; and ballistic, nuclear, and directed energy effects.

UNIQUE FACILITIES

Blast Range - Comprised of three air-driven shock tubes (0.6, 1.7, and 2.4 meters in diameter) used to simulate air blasts from conventional/nuclear weapons; largest air-driven shock tubes in U.S.

Large-Caliber Experimental Test Facility - Self-contained diagnostic test range having unique capability of performing full interior ballistic testing and evaluation from initial ignition and combustion of propelling charge, through inbore travel, to muzzle exit; able to test advanced conventional propulsion technologies, electrical propulsion concepts, and other innovative propulsion schemes.

U.S. Army Research Laboratory (Continued)

High Performance Computing Resources - Provides researchers and other customers with access to high-performance computer systems including both scalable massively parallel processors and parallel vector architectures.

Acoustic Source Generation System - Reproduces realistic signals simulating any sound at various ranges and under controlled conditions; no other system with comparable features exists in the world today.

High Power Microwave Research Facility - Unique 100-kilowatt facility consisting of a large anechoic chamber, a large variety of microwave sources, and an extensive array of diagnostic equipment; capable of performing tests at higher powers and more frequencies than any other known facility.

HIFX Flash X-Ray Facility - Designed to test electronic components and systems for radiation effects.

AURORA Pulsed Radiation Facility - World's largest gamma-ray simulator for testing the survivability of both tactical and strategic systems.

Ion Implantation Facility - Provides unique state-of-the-art capability for the development/demonstration of novel ion surface treatments and coating techniques.

Pulsed Power Center - Unique facility in our country which serves as the focal point for all three Services for pulse power technology and development/evaluation of high-power/high-voltage components and subsystems.

Nanoelectronic Fabrication Facility - Consists of a variety of unique equipment to grow and characterize compound semiconductor materials and fabricate devices; contains two molecular beam epitaxy systems, an electron-cyclotron resonance plasma-etched chemical vapor deposition and etching system, a magnetron-enhanced reactive-ion etching system, a rapid thermal annealing system, microlithography system, and more.

Ultralithography Center - Provides Army and DoD with capability for the development and novel ultra-submicron electronic device technology; contains Leica EBPG-5HR electron-beam lithography system.

Indoor/Outdoor Robotics and Automation Research and Test Facility - Includes outdoor 14 acre test area with 25 mph sustained speed test track, obstacle course, explosive ordnance disposal robot court and indoor 35,000 square foot test area with radio frequency (RF) position location system, data acquisition equipment, and computing facility for development of robotic and related technologies.

U.S. Army Research Laboratory (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ARL ORTA is contained within the Advanced Concepts and Plans (ACAP) Directorate which is located at ARL Headquarters Adelphi, Maryland. The actual functioning of the ORTA is under the responsibility of the ARL Domestic Technology Transfer Program Manager, R. Michael Claffy. The office consists of a staff equivalent of 9.8 person years. The operating budget is approximately \$950K. A specific ORTA point of contact is designated for each of the ten technology directorates within ARL.

Publicity: The ARL Domestic Technology Transfer (DTT) program shares in the benefits provided by ARL's substantial investment in marketing tools and displays which have been developed for use by the DTT program as well as other ARL programs. Four different full color, modular displays have been procured and are maintained by the ACAP directorate. They are used in technology trade shows, conferences, association meetings, etc., usually on 10 to 15 occasions throughout the year. The displays range in size from a 20 foot floor display, to a 4 to 6 foot table top model. Each display is configured depending on the specific exhibit theme or potential "customer group" attending the conference. Other marketing tools range from tri-fold single page hand outs, up to 20 to 30 page full color brochures. The ARL DTT program is specifically listed in 7 different publications and resource catalogs. Formal advertisements are placed in Technology Transfer magazines once or twice each year.

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	200	150

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	850	700

Typical Publications and Forums:

- * Army Operations Research Symposium Proceedings
- * Institute of Electrical and Electronic Engineers (IEEE) Journal of Electron Devices
- * IEEE Transactions on Information Theory
- * IEEE Transactions on Communications
- * Journal of Applied Physics
- * Journal of the Electrochemical Society
- * Journal of the Optical Society of America
- * Physical Review

U.S. Army Research Laboratory (Continued)

Selected Titles:

- * *An Experiment to Examine Protocol Performance Over Tactical Networks*
- * *A Preliminary Method for Atmospheric Soundings in Near Real-Time using Satellite and Ground Based Remotely Sensed Data*
- * *An Electron Paramagnetic Resonance Investigation of Extrinsic and Intrinsic Defect Center in Pb (Zr, Ti) O₃ Ceramics*
- * *Optical Studies of Electroluminescent Structures from Porous Silicon*
- * *Effect of Void Content on the Mechanical Properties of Carbon/Epoxy Laminates*
- * *Evaluation of Body Armor Systems Against the 19.5-Grain Flechette*
- * *Characterization of PMR Monomer Solutions and Prepregs using HPLC Analysis*

CONFERENCES AND SYMPOSIA

CONFERENCES AND SYMPOSIA	FY92	FY93 (through June)
Approximate Number Attended	280	220

Selected Conferences and Symposia:

- * American Defense Preparedness Association Conference on Turbine Engine Diagnostics
- * Advanced Research Projects Agency (ARPA) Software Technology Conference
- * Society for Photo-optical Instrumentation Engineers (SPIE) 1993 Symposium on Optical Engineering and Photonics in Aerospace & Remote Sensing, Orlando, FL
- * 26th International Conference on Radar Meteorology Symposium, Myrtle Beach, SC
- * The Physics of Semi-Conductors
- * Association of Old Crows Symposium Joint Western-Mountain Region EW Tech Symposium
- * Precision Munitions, Signatures and Simulators Conference

EXCHANGE PROGRAMS

During FY92 ARL was a participant in 340 exchange programs and was a participant in 355 exchange programs during FY93.

Selected Exchange Programs:

- * Several panels of The Technical Cooperation Program (TTCP)
- * Dr. A. Charles Sobrero from the DuPont Experimental Station
- * Graduate Internship Program with Ohio State University

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
360	\$128 M	428	\$96 M

U.S. Army Research Laboratory (Continued)

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities: ARL donated over \$300K worth of equipment to Universities in FY92 and \$630K in FY93 (depreciated value). The equipment consisted of some of the following:

- * IBM compatible 8088 and 286 personal computers
- * CAD Systems
- * Apollo Central Processing Units Model GD52
- * Control Data Hard Drives
- * Tegal Model 701 Plasma Etchers
- * Micromanipulator Servomotor Transducers

URI and Centers of Excellence: ARL had interactions with a total of 10 URI's during FY92 and 13 URI's during FY93, of which two examples are shown below:

- * University of Delaware - URI Manufacturing of Polymeric Materials (member of the oversight board)
- * URI on Smart Materials and Structures - (member of the review board)

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
FY92		FY93	
PHASE I	PHASE II	PHASE I	PHASE II
\$2,750 K	\$11,150 K	\$2,200 K	\$13,750 K

USE OF LABORATORY FACILITIES

- * A Memoranda of Understanding between Fort Monmouth NJ, (including both EPSD as well as CECOM) allows the New Jersey Commission of Science and Technology to identify selected students and facility to come in and use EPSD facilities. The work focuses on solving problems which are proposed by the EPSD and are directed toward supporting the Army's mission
- * The National Research Council (NCR) Post Doctoral program at EPSD sponsors students to work on topics which solve selected problems related to the Army's needs. Topics are jointly defined and the researchers are then provided access to high technology facilities and equipment at EPSD. Examples of such facilities are MBE machines and Microanalytical equipment. Microanalytic equipment such as the Mass spectrophotometer can determine the presence of minute amounts of contamination in both bulk and thin-film semiconductor materials.
- * Under a CRDA, Integrated Technologies for Medicine, Inc. is using ARL's microfabrication facility to support their development of new processes for micromachining devices in silicon wafers. As a result of this effort, ARL is gaining equipment upgrades, improvements and enhancements.

U.S. Army Research Laboratory (Continued)

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
52	20

Active CRDA's Titles:

- * *For research and educational collaboration in composite materials manufacturing science*
- * *For development of permanent magnet designs for use in magnetic resonance imaging systems*
- * *For development of optical, infrared, and microwave detectors using super-conducting technology*
- * *For development of smart ceramic materials*
- * *For development of a portable flat panel display workstation*
- * *For development of a laser microscopy system for the commercial market*
- * *For development of advanced automated manufacturing systems*
- * *For experimental and analytical impact dynamics research for composite rotorcraft structures*

Non-Monetary Contributions: The non-monetary contributions of ARL's active CRDAs is approximately \$5M.

Reasons for Backlog: The reasons for the backlog of CRDAs under negotiation are:

- (1) The uniqueness of each agreement precludes a common format; having to tailor each one requires an extra time burden. (Attempts to establish such a common format are continuing).
- (2) The time required for the legal review process is lengthening due to a severe shortage of legal staff and the inability, due to a hiring freeze, to hire replacements to mitigate that shortage.
- (3) There is some evidence of a reluctance on the part of certain sections of private industry to trust the ability of the Federal Government to adequately protect proprietary information.

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
74	124	2	\$72.5K

Selected Patent Titles:

- * *Compensation for Magnetic Non-uniformities of Permanent Magnet Structures*
- * *Thin Film Thickness Mapping Technique*
- * *Stepped Magnetic Field Source*
- * *High Temperature Molten Salt Electrochemical Cell*
- * *Light Activated High Power Integrated Pulser*
- * *Photoconductive Avalanche GaAs Switch*

U.S. Army Research Laboratory (Continued)

Selected Patent Application Titles:

- * *An Optically Controlled Oscillator*
- * *A Variable Gain Optical Detector*
- * *Ultra-wideband High-Power Photon Triggered Frequency Independent Radiator*
- * *Microstrip Electronic Scan Antenna Array*
- * *Battery Connector and Method*
- * *Hemispherical Cladding for Permanent Magnet Solenoids*

Number of CRDA's That Provide Trade Secrets: 8

Backlog in Patent Applications: The backlog in patent applications has increased from 186 in FY92 to 218 in FY93.

Attorneys Supporting DTT: There are essentially only three full time equivalent (FTE) legal professionals supporting DTT. There are only two other FTE legal professionals providing mission related intellectual property support not specific to DTT, that is they evaluate proposed patentable concepts that are presented by ARL's Scientists and Engineers (S&E). They then process those patent applications selected as the most promising or the most valuable to protect from the Army's viewpoint. This total of 5 FTE professionals is down from a high of 9.5 FTE's just in the past 14 months. The current operating budget for legal support to DTT is \$250K (direct charge labor only) including \$30K for travel. The requested operating budget is \$500K for DTT and an increase of \$300K to the current amount of \$300K is being allocated for the other areas of intellectual property protection.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

ARL is a co-partner in 22 TRP proposals that are currently under going the selection process at the Advanced Research Projects Agency (ARPA). Winning proposals are expected to be announced in 1QFY94. To date, an estimated \$275K has been expended toward the TRP program by ARL. This figure will increase significantly if any of the proposals having ARL as a partner are selected.

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * Department of Commerce-National Institute of Standards and Technology (NIST) - Calibration standards for instruments used at ARL and collaborating in a joint robotics program
- * National Oceanic and Atmospheric Administration - Perform joint airborne measurements, analysis of chemical aerosols, etc.
- * Department of Energy (DOE) - Several collaborative efforts with DOE labs on the dynamic behavior of composite materials, Sandia NL, Lawrence Livermore NL, Los Alamos NL, etc.
- * National Science Foundation (NSF) - Sponsors joint conferences
- * NASA - Two of ARLs directorates are collocated with NASA facilities (NASA Lewis and NASA Langley)

U.S. Army Research Laboratory (Continued)

Typical Interactions with State and Local Governments:

- * Montgomery County/Suburban Maryland High Technology Council - ARL is a member of the council which promotes contacts with small and medium sized businesses in the county
- * Baltimore/Washington Corridor Chamber of Commerce - Member
- * D.C. National Guard, Alabama State Police, and Fairfax County (VA) Police - Works in areas related to ARL technologies which can assist in drug interdiction

Typical Interactions with Industry:

- * I.E. DuPont - Periodically analyze kinetic data sets for Experimental Station, Wilmington, DE; in return, DuPont provides experimental characterization of diffusion and kinetic parameters

Typical Interactions with Academia:

- * ARL has thirteen Education Partnership Agreements in place and active
- * S&Es act as mentors in the Science and Engineering Apprentice Program (SEAP)
- * University of Maryland - Sponsor National Research Council Post Doctorate
- * University of California/Berkeley - Involved in joint research to develop a reduced instruction approach to computer-aided design
- * Interagency Personnel Agreements (IPA) - With professors at various universities (e.g. Dr. Gurdeke at New Mexico State University)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

FY93:

1. ARL has over the past 5 years, developed a rather high CRDA to Scientist and Engineer (S&E) ratio. (The highest in DoD, outside of DoD, second only to possibly NIST.) So far this year several new marketing tools have been developed:
 - a) An ARL DTT handout which provides a brief description of ARL, the DTT program technology transfer mechanism, and ORTA POCs. Over 700 have been handed out.
 - b) An ARL DTT Brochure, a handbook which provides more detail on the DTT program and describes each technical directorate of the laboratory. This brochure will be completed in late fourth quarter FY93. It will be a full color, 16 page brochure that will become one of the primary marketing tools for ARL's DTT program during FY94.In addition to these marketing tools, training programs were initiated at five of the ten directorates (at two different sites).

FY94: Efforts in FY94 will focus on:

1. Collecting data to determine the payoff or benefits of prior CRDAs.
2. Developing additional marketing tools e.g., one page technology descriptions for all areas of ARL's research judged to have high potential for commercial application.
3. Preparing a compendium of Technical Outreach Activities for ARL in FY93 and for its predecessor organization, LABCOM, from FY86 to FY92. This document will be primarily an historical record, but will also be used as a marketing tool to depict the potential areas in which we can launch new outreach activities.
4. The new ARL DTT data base will be delivered in early FY94. This is a contractual effort being performed by SPARTA in Huntsville, AL. Once this data base is in place, report generation for the ARL DTT program will be improved ten fold.
5. The growth rate of CRDAs and PLAs tapered off during FY93. A concerted effort will be made to bring the growth rate back to the approximate 25% per year rate of prior years.
6. There are still some ARL Directorates without one CRDA or PLA. While it has been argued that some military oriented technologies do not lend themselves to dual use applications, this argument is losing its supporters. We will strive to achieve participation by every Directorate during FY94.
7. The training programs initiated independently at the Aberdeen Proving Ground and the Fort Monmouth sites will be institutionalized and presented at the other ARL geographic locations.
8. ARL provided formal offers of support to four different proposals submitted to the Technology Reinvestment Project (TRP). We will provide the offered support to the winning candidates, and be watching for the FY94 announcement of TRP.

U.S. ARMY SPACE & STRATEGIC DEFENSE COMMAND

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ORGANIZATIONAL AREAS OF EXPERTISE

Technology studies and experiments in directed energy weapons and interactive discrimination devices.

Initiation and control of exploratory R&D of hypervelocity technology advanced propulsion, interceptor technology, aerodynamics, guidance and control, and millimeter wave technology in support of interceptor technology.

Exploratory research and advanced development of optical technologies, passive and active sensors, and microelectronics radiation hardening technologies.

Systems analysis, systems engineering, and command, control, and communications for Ballistic Missile Defense (BMD) technology development programs.

Survivability, lethality, and key technologies including radiation hardening, composite materials/processes, non-volatile memory, power and power conditioning, structures, superconductivity, and advanced optical materials.

Research and development in the areas of innovative sensors, advanced signal processing, digital imaging technology, artificial intelligence, distributed computing, thermo-electron technologies, kinetic and directed energy, optical computing, laser satellite communications, advanced materials, and computer security.

Space technology research and development in the areas of communications, remote sensing, weather and terrain data, space experiments, position/navigation, and space technology transition.

UNIQUE FACILITIES

Kwajalein Missile Range (KMR) - Major range and test facility base supporting strategic defense research and technology validation programs as well as strategic offensive weapons development and operational testing; assists in tracking and monitoring NASA space missions; provides deep-space tracking for U.S. Space Command.

High Energy Laser Systems Test Facility (HELSTF) - Supports Army and DoD high energy laser RDT&E; develops, integrates, and operates high energy lasers and related instrumentation, facilities, and support systems; conducts and evaluates laser effects tests.

U.S. Army Space & Strategic Defense Command (Continued)

Airborne Surveillance Testbed (AST) - Three-color sensor mounted on a modified Boeing 767 used to validate Long Wave Infrared (LWIR) sensor functional performance and to collect infrared data on a wide variety of test targets.

Advanced Research Center (ARC) - Contractor-operated computer facility created to support Strategic Defense Initiative programs; distributed and parallel processing capabilities; major node in the National Test Bed (NTB).

Army Missile Optical Range (AMOR) - Contractor-operated compact laser radar range, primarily supporting laser and Laser Radar (LADAR) measurements of selected materials and targets.

COBRA EYE - Collection platform for longwave infrared data on a wide variety of strategic and theater missiles and proposed pen aids.

COBRA JUDY - Ship-borne sensors designed to collect high quality signature data on missile systems.

High Altitude Observatory (HALO) - Instrumented Gulfstream II-B optical data collection aircraft providing multispectral, imaging, optical signature, missile plume phenomenology, intercept, debris characterization, and kill assessment data.

Lexington Discrimination System Test Bed (LDSTB) - Uses actual filed data to test discrimination algorithms and architectures in real time.

Mosaic Optical Sensor Technology Testbed (MOSTT) - Supports development, characterization, testing and calibration of low background, infrared surveillance sensors and interceptor seekers.

National Institute of Standards and Technology (NIST) Low Background Infrared (LBIR) Calibration Facility - Supports development of LBIR calibration standards.

U.S. Army Space & Strategic Defense Command (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

Technology Transfer at USASSDC is a command-wide function. It is estimated that 6 man-years of effort is expended for this activity. There is not a budget set aside explicitly for technology transfer. The Systems and Programs Integration Office acts as the focal point for these activities.

Publicity:

- * Automated Technology Catalog
- * Technology Transfer Program Brochure
- * USASSDC Patent and License Catalog
- * USASSDC Technology Transfer (Spinoff) Notebook
- * The Technology Network Newsletter (bimonthly)
- * Media Briefings (2)
- * Technology Conferences (2)
- * Meeting/Conference Exhibits (25 in FY92 & 20 in FY93)
- * Radio (7)
- * USASSDC Dual-Use Technologies Publication
- * Newspaper/newsletter articles (5)

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	8	3

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	46	23

Typical Publications and Forums:

- * American Defense Preparedness Association Proceedings
- * Army Research Development and Acquisition (RD&A) Bulletin
- * Aviation Week
- * Institute of Electrical and Electronic Engineers Proceedings
- * Society for Computer Simulation Proceedings
- * The International Society for Optical Engineering Proceedings

U.S. Army Space & Strategic Defense Command (Continued)

Selected Titles:

- * *Mosaic Array Compression And Processing*
- * *High Bandwidth, Wide Field of View Lasercom*
- * *Solid Propellant Electrothermal Gun Propulsion*
- * *Advanced Composite Interceptor Kill Vehicle Structures*
- * *Endo-Leap Flight Test Planning*
- * *Ground-Test Performance Validation for Army Hughes Leap Kill Vehicle*

CONFERENCES AND SYMPOSIA

Conferences Attended: 15

Selected Conferences and Symposia:

- * Federal Laboratory Consortium, Southeast Region
- * Directed Energy Conference, Huntsville, AL
- * Other Government Agency Briefing, Huntsville, AL
- * American Institute of Aeronautics and Astronautics (AIAA) Missile Science Conference, Monterey, CA
- * Technology Transfer Society Annual Meeting, Ann Arbor, MI
- * AIAA 2nd Strategic Defense Initiative Office (SDIO) Interceptor Technology Conference, Washington, DC
- * AIAA Space Programs and Technology Conference, Huntsville, AL
- * Visions of the Year 2000: A Strategic Software Perspective, Huntsville, AL

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * University of Alabama-Huntsville
- * University of Alabama-Tuscaloosa
- * Alabama A&M University
- * Auburn University
- * Wallace State
- * Drake Technical College
- * Middle Tennessee State University

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
207	\$785.5 M	172	\$104.1 M

U.S. Army Space & Strategic Defense Command (Continued)

Selected Contracts to Commercialize Technology:

- * Development of a diamond coating materials processing technology through a SBIR contract to: 1) Improve technology for heat sinks and thermal management; and 2) Enhance capabilities of radar, optical discrimination, and intercept functions. It makes possible the deposition of diamond films on a wide variety of substrates and shapes. Commercialization applications include: 1) Reinforcement for advanced composites in airframes and missiles; 2) Optical, X-Ray, and particle beam windows; 3) Machine tool and insert coating; 4) Surgical tool coating; 5) Semiconductor wafers; 6) Multi-chip modules and heat sinks for electronic packaging; 7) Fiber optic communications, etc.
- * Irvine Sensors Corporation (ISC), under a SBIR contract developed and integrated chip-stacking technology for infrared focal plane arrays. The technology is to be further developed by ISC and IBM to enable more compact, powerful, and rugged computing systems.

Selected Commercialized Technologies:

- * Development of optical waveguides, through a SBIR program with Physical Optics Corporation, has resulted in the development and marketing of over 50 one- to four-channel wavelength division multiplexers. The wavelength division multiplexers are used in space-based surveillance networks, commercial computer networks, communications applications, fast optical data buses, fanouts, multichip module optical interconnects, and chip-level spectrometers
- * Developed the basis for manufacturing structural foams to insulate hot gas nozzles in rockets, through a SBIR program with Ultramet, Inc. A hip joint manufacturer has signed an agreement to use the structural foams for musculoskeletal applications, pending approval from the Food and Drug Administration. The automotive industry is also looking at utilizing the material in exhaust systems to control volatile organic content emission levels.

GRANTS AND COOPERATIVE AGREEMENTS

URI and Centers of Excellence:

University of Minnesota - Supercomputer knowledge and use

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
PHASE I	FY92 PHASE II	PHASE I	FY93 PHASE II
\$892 K	\$2,729 K	\$712 K	\$4,470 K

USE OF LABORATORY FACILITIES

Kwajalein Missile Range:

- * National Aeronautics and Space Administration
- * Lawrence Livermore National Laboratory

U.S. Army Space & Strategic Defense Command (Continued)

High Energy Laser Systems Test Facility:

- * Sandia National Laboratories
- * University of Colorado
- * Orbital Sciences Corporation
- * Thomson-Ramo-Woolridge (TRW) Incorporated
- * United Technologies Corporation
- * Tracor Aerospace Incorporated
- * Bendix Corporation

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
2	5

Active CRDA's Titles:

- * *Modifying the Government Owned Distributed Computing Design System (DCDS) for Hosting on CONVEX Hardware*
Partner: CONVEX Computer Corporation
- * *Hosting the DCDS Software on a Variety of Computer Platforms*
Partner: Navajo Technologies Incorporated

Non-Monetary Contributions:

- * Government owned copyright
- * Personnel
- * Equipment
- * Facilities

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
4	7	N/A	N/A

Selected Patent Titles:

- * *Particle Beam Accelerator Electromagnetic Arc Detection System; 5,142,234*
- * *Composite Rocket Propellant Composition with a Controllable Pressure Exponent; 5,059,260*
- * *Solid Stripper for a Space Based Neutral Particle Beam System; 5,177,358*
- * *Cloth-Lined Interceptor Motor Insulation for Strong Insulation-to-Propellant Interlock; 5,209,876*

U.S. Army Space & Strategic Defense Command (Continued)

Selected Patent Application Titles:

- * *Microcoacervation of Propellant Ingredients*
- * *General Aspherical Surface Optical Testing Device*
- * *Electron Beam Driven Negative Ion Source*
- * *Method of Manufacturing Hybrid Fiber-Reinforced Composite Nozzle Materials*
- * *Nitrato-Nitro-Containing Hydroxyl-Terminated Polybutadiene-Based Propellants*
- * *Non-Composite, Thermoplastic, High Temperature-Resistant Rocket Motor Cases*
- * *Laser Pulsed Fiber Optic Neutron Detector*

Backlog in Patent Applications: There is currently a backlog of 20 invention disclosures for which patent applications have not been filed. The backlog is due to a reduction in the staff of the MICOM Legal Office and an increase in the rate of disclosure submissions. The professional staff was reduced from 10 to 6 persons in the last four years and the support staff was reduced from 7 to 2 persons in the last two years. The positions were vacated due to retirements and transfers, could not be filled due to the hiring freeze, and most were lost in a recent reduction in force.

Attorneys Supporting DTT: Legal support for USASSDC is provided by the MICOM Legal Office who also supports other Army elements co-located at Redstone Arsenal. The MICOM Legal Office has a total of four patent attorneys and two patent advisors to provide support for procurement matters, patent disputes, claims, and DTT matters. The grade structure for the professional staff consists of one GM-15, four GS-14's, and one GS-13. Out of the four patent attorneys, only one patent attorney provides direct support on DTT matters to USASSDC and the other co-located Army elements.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

USASSDC provided man-hours and resources to support the TRP initiation and proposal team formation/proposal development. USASSDC provided approximately 48 man-hours during the initial TRP stages for attending three information meetings and interfacing with the local Huntsville/Madison County Chamber of Commerce for coordinating with consortium meetings (approximately 10) and providing information on USASSDC technologies.

As of the end of July, six commitment letters, coordinated by the ORTA, have been approved or are in approval to assist those Industries participating in the TRP efforts. They are as follows:

- * Alabama Chamber of Commerce - Regional Technical Alliance Assistance Program
- * Energy Power Research Institute - Defense Dual-Use Critical Technology Partnership Program
- * Litton Industries and Teledyne Brown Engineering - Optoelectronic technologies
- * Essex - Image optical processing
- * Electric Power Research Institute and COLSA Corporation-Huntsville - Internet development
- * Controlex Corporation (in approval) - Solid State Non-Volatile Mass Memory Initiative.

In response to a request from the University of Alabama-Huntsville for information on dual-use technologies, USASSDC created the "USASSDC Dual-Use Technologies" publication. Approximately 96 man-hours were contributed to this publication. This 56 page overview of USASSDC technologies provided the University of Alabama-Huntsville information to support university initiatives as part of the TRP.

U.S. Army Space & Strategic Defense Command (Continued)

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * National Aeronautical and Space Administration (NASA) - Potential technology transfer opportunities and technology need assessments were pursued through contacts with the NASA Marshall Space Flight Center and NASA's Strategic Avionics Technology Working Group (SATWG). A Technical Interchange Meeting (TIM) took place in March 1992 between USASSDC Technologists and representatives from NASA's Earth Observatory System Program to determine if NASA could exploit USASSDC programs.
- * COSMIC - This NASA Sponsored software center is co-located with the University of Georgia. Discussions to incorporate USASSDC software technology in their database are ongoing.
- * Tennessee Valley Authority (TVA) - USASSDC participates in local joint initiatives with MICOM, TVA, and NASA.
- * Other Government Agencies (OGA) Technical Interchange Meetings (TIM)- USASSDC participates in OGA Technical Interchange Meetings on an annual basis.
- * National Technology Transfer Center (NTTC) - USASSDC representatives visited the National Technology Transfer Center to participate in Technology Transfer-related activity.
- * The Federal Laboratory Consortium (FLC) - USASSDC participated in national and regional FLC meetings to investigate potential technology transfer opportunities.
- * The Office for National Drug Control Policy (ONDCP) - Pursued potential technology transfer opportunities and technology need assessments.
- * Southern Technology Applications Center (STAC) - USASSDC interacted with the STAC NASA Regional Technology Transfer Center to carry out Technology Transfer activities.
- * Department of Energy
- * Department of Transportation, including the U.S. Coast Guard.

Typical Interactions with State and Local Governments:

- * Alabama Commission on Aerospace Science and Industry
- * Alabama Department of Economic and Community Affairs - To investigate potential Technology Transfer possibilities.
- * North East Alabama Regional Small Disadvantaged Business Agency -Technology transfer opportunities and technology need assessments were investigated.

Typical Interactions with Industry:

- * The Huntsville/Madison County Chamber of Commerce - Supports the Huntsville Alabama Chamber of Commerce Subcommittee on Technology Transfer. Expanded tasks include consortium participation, visitations with local industries, and the handling of problem statements.
- * IBM - Nearly completed a CRDA for re-hosting the USASSDC-developed Distributed Computing Design System (DCDS) onto their computer platforms.
- * Teledyne Brown Engineering - Investigating entering into a CRDA for commercializing the Data Processor Simulation Model (DPSIM) software.
- * CRAYDEC - Investigations are being conducted to determine if a CRDA can be established re-hosting DCDS onto their computer platform.
- * Silicon Graphics - Investigations are being conducted to determine if a CRDA can be established re-hosting DCDS onto their computer platform.
- * COLSA - Investigations are being conducted to determine if CRDAs can be established between USASSDC and COLSA for converting software developed by COLSA for USASSDC into commercial products.

U.S. Army Space & Strategic Defense Command (Continued)

Typical Interactions with Industry (Continued):

- * S.Y. Technologies - A potential sensor spin-off from S.Y. Technologies of Huntsville to the medical community is being pursued by USASSDC.
- * The Huntsville Chapter of the Technology Transfer (T2) Society - USASSDC played an active role by participating in meetings and other T2 Society activities and by utilizing the diverse network of individuals in the Society as points of contact for T2 opportunities.

Typical Interactions with Academia:

- * The University of Alabama in Huntsville (UAH) - A CRDA between USASSDC and UAH for Systems, Simulation, and Software Technology Development is being developed. A Partnership Intermediary Agreement (PIA) with USA Missile Command (MICOM) and UAH was also drafted to hold a T2 Symposium at UAH in the summer of 1992.
- * University of Tennessee-Oak Ridge Institute of Science and Education - Being considered for the site for the implementation of a USASSDC Technology Transfer Training Plan.

U.S. Army Space & Strategic Defense Command (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

1. Laboratory Technical Expertise

The U.S. Army Space and Strategic Defense Command (USASSDC) will continue to focus on technology efforts which are required to support strategic and theater missile defense systems. These technologies are included in the areas of sensors, kinetic and directed energy weapons, systems engineering and analysis, simulations, advanced technologies, survivability, lethality, materials, targets, test, and evaluation.

2. ORTAs and DTT Focal Points

There are no expected increases in the number of personnel staffing the ORTA or in support contractor personnel. There are plans to upgrade the Technology Transfer brochure and newsletters in FY94 to include more current information. The Dual-Use Technology catalog which was developed in FY93 is planned to be a yearly publication. Within select publications/tools, a standardized questionnaire for feedback on effectiveness of the product will be inserted.

3. Publications

The USASSDC will continue to actively encourage its scientists and engineers (S&E) to publish unclassified and nonsensitive papers in technical journals and conference proceedings. Although the amount of publications for FY94 will be largely due to individual initiatives on the part of the S&E's, the USASSDC will improve the spread of information about upcoming "calls for papers", etc.

4. Conference and Symposia (HQ & Labs)

The USASSDC will continue to host its annual Other Government Agency meeting in July. There are plans for the command to host a series of workshops beginning in FY94 to focus on disseminating information about USASSDC technologies. The USASSDC will be an active participant in the American Institute of Aeronautics and Astronautics (AIAA) Space Programs and Technologies Conference and the AIAA Missile Sciences Conference. The command will try to further enhance participation at conferences and symposia by improving the flow of information to the scientists and engineers throughout USASSDC as described above in publications. In addition, include increased focus and participation in professional organizational conferences and symposia in support of the USASSDC's Technology Transfer marketing strategy objectives. For example, improvements can be made to the Command's stand-up exhibit which will explain the utility of technology transfer.

5. Exchange Programs and Visits

With the enrollment of several USASSDC scientists and engineers into the Army Acquisition Corps, there should be more opportunities for long-term training at universities throughout the U.S. in FY94. Pending approval of the CRDA between USASSDC and the University of Alabama in Huntsville (UAH), a mechanism would be in place for the increased exchange of personnel in FY94.

U.S. Army Space & Strategic Defense Command (Continued)

6. Contracts

The USASSDC receives the majority of its funding through Program Management Agreements with the Ballistic Missile Defense Organization. Recent budget information shows that the amount of funding for R&D contracts is not likely to increase significantly for FY94. Investigate feasibility of "Dual-Use and/or Commercialization Clause" as a part of future contracts.

7. Grants and Cooperative Agreements

Investigate reinstitution of grant authority for USASSDC.

8. Use of Laboratory Facilities

Advertise availability of ARC, Simulation Center, HELSTF, KMR and other laboratory environments.

9. CRDAs

Increase the focus on and make available specific technologies with commercial CRDA applications through interviews, talk shows, industry briefings, and symposia. Continue to pursue shortened review and approval cycle times with respect to legal issues.

10. Intellectual Property

Increase dissemination of patent and dual-use documents to target industries and academia.

11. Technology Reinvestment Project (TRP) Efforts

More involvement is anticipated in this area as contracts are awarded.

12. Interactions with Non DoD Organizations

Increase interaction with industry at conferences and expositions. Target, then promote, technologies to industry at conferences/expositions as potential partners/buyers.

U.S. ARMY TANK-AUTOMOTIVE RD&E CENTER

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ORGANIZATIONAL AREAS OF EXPERTISE

Ground vehicle signatures; millimeter wave, infrared, visual, magnetic, seismic, and acoustic; and simulation of ground vehicle signature environments.

Psychophysical modeling of human perception.

Analysis, computer modeling and physical simulation of ground vehicle ride dynamics, stability and safety; including commercial trucking.

Ground vehicle mobility analysis for terrains worldwide and dynamic analysis and computer modeling of vehicle structures.

Thermal stress analysis modeling of engine components.

Automatic fire detection and extinguishing.

Teleoperation and autonomous robotic systems for off-road and highway vehicles guidance.

Precision welding of large armor structures.

Large automotive composite structures applications, design, manufacture, and repair.

Virtual reality prototyping of vehicle systems.

High-speed tracked-vehicle suspension, steering, stability, and dynamics.

Heavy off-road ground vehicle propulsion system integration, including cooling, air filtration, and electric drive systems.

Infrared imaging of high-speed events.

Concept development, design, and prototype fabrication of light through heavy class special purpose ground vehicles for on-road or off-road duties.

Advanced design and manufacturing processes, incorporating automated/flexible manufacturing planning, and computer-aided design.

Integration of ground vehicle control systems for electric power, control, and computer data (Vetronics).

U.S. Army Tank-Automotive RD&E Center (Continued)

UNIQUE FACILITIES

Cray 2 Supercomputer - Used for structural analysis, vehicle stability, and dynamics studies.

20-ton Capacity Ride Motion Simulator - A computer-controlled 6-axis (3 linear, 3 rotational), hydraulically-driven simulator, capable of mounting an M1 tank turret, and moving the turret in a computer-controlled simulation of the complete tank traversing specified courses at a remote test site. Permits the motions of a particular run over a test course to be exactly repeated, which is unattainable with actual driving.

Laminate Object Modeling (LOM) System - A system for rapidly constructing model or light-duty prototype mechanical parts directly from Computer-Aided Design (CAD) computer files. The system builds objects as large as 14.5" by 10" by 14" from progressively applied layers of paper or plastic sheet.

Extreme Resolution Stereoscopic Display - A boom mounted stereoscopic vision system, for visualizing in 3 dimensions, any computer-generated scene from any desired position and angle. Permits realistic interior and exterior views of new vehicles, with no physical limitations on the operator's position. Used to rapidly evaluate man-machine interfaces and to resolve potential equipment location conflicts before any physical prototypes are fabricated. A vital element in virtual prototyping operations.

1500 Horsepower Powertrain Test - Facilities for testing complete engine, transmission, cooling, air cleaner, and driveline systems for both wheeled and tracked propulsion, up to 1500 horsepower, in simulated environments up to 120 degrees Fahrenheit, with solar radiation and winds.

Mechanical Component Test Facilities - Vehicle braking and hydraulic systems testing.

Vehicle Crew Station Simulation Facility - A three-place advanced vehicle crew-station test system, equipped with advanced crew displays and controls, and computerized scene generation. Used to research new control methods, crew configurations and sizes, and advanced vision systems for vehicle crews.

Armor Test Lab - An indoor firing range facility, equipped with two closed-tube firing systems. Permits firing projectiles up to 30 millimeters in diameter within closed tubes, against armor material test samples. Used to evaluate the armor protection of lightly armored vehicles.

Vehicle Fabrication Area - A prototype fabrication and low-rate production facility capable of designing and fabricating a complete tank, or any other off-road or highway special-purpose ground vehicle.

Vehicle Test Track - A 1-1/2 mile test track suitable for heavy vehicles, including tanks.

U.S. Army Tank-Automotive RD&E Center (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA is staffed by two full-time personnel with a travel budget of \$25K per year. The office integrates Small Business Innovation Research (SBIR), In-House Research and Development (IR&D), Army Research Office (ARO) projects, Unsolicited Proposals (UP), Technical Industry Liaison Office (TILO), with the normal ORTA technology transfer (TT) mission for improved TT communication and effectiveness. TARDEC associates frequently staff TARDEC technology marketing displays at shows and conferences. The man-hours contributed are not charged to the ORTA, though the labor contributes directly to TARDEC TT success.

Publicity:

- * Technology marketing displays at shows and conferences
- * Established the National Automotive Center to facilitate the domestic automobile industry's access to the federal laboratory system
- * Hold an annual Business Fair in Warren, MI
- * Interaction with MERRA, a non-profit organization which assists Michigan science and engineering small businesses
- * Developed new summaries of TARDEC business and capabilities for distribution to small businesses
- * Organized the USCAR Automotive Technology Exposition, which over 1000 people attended

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	26	23

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	129	141

Typical Publications and Forums:

- * Experimental Mechanics
- * Journal of Applied Physics
- * Magazine of the Association for Unmanned Vehicle Systems
- * Optical Engineering
- * Physical Sciences Review
- * Proceedings of the Summer Computer Simulation Conference
- * Society of Automotive Engineers Technical Papers

U.S. Army Tank-Automotive RD&E Center (Continued)

Selected Titles:

- * *Computer-Based Analysis and Comparison of the U.S. and Russian Heavy Equipment Transport Systems*
- * *Thermomechanical Analysis of a Low Heat Rejection Cylinder Head*
- * *Intelligent Mobility: Dual Use for Manned and Unmanned Applications*
- * *Vehicle Design Sensitivity Analysis Through the Use of Performance Surfaces*
- * *Comparative Performance of Active Suspension Concepts*
- * *First International Ground Robotics Competition In 1993*
- * *TARDEC Eyes Electron Beam Curing for Composite Materials*
- * *Technical Development of the Combat Vehicle Tele-Operation Kit (CVTK)*

CONFERENCES AND SYMPOSIA

<u>CONFERENCES AND SYMPOSIA</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Number in Which Presented	20	25

Selected Conferences and Symposia:

- * 11th International Conference of the International Society for Terrain Vehicle Systems, Lake Tahoe, NV
- * Advance Planning Briefing for Industry, Dearborn, MI
- * First Annual Ground Robotics Competition, Oakland University, Rochester Hills, MI
- * TACOM-Industry Logistic Data Symposium, Dearborn, MI
- * Society of Automotive Engineers Annual Congress, Detroit, MI
- * Society of Automotive Engineers Off-Highway Conference, 1993
- * Armor Conference
- * Ground Mobility Conference

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * Army High Performance Computing Research Center
- * Martin-Marietta Defense Systems
- * General Dynamics
- * Education Partnership with Wayne State University
- * Armored Vehicle Technologies

RDT&E CONTRACTS

<u>FY92</u>		<u>FY93</u>	
<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>	<u>NUMBER OF CONTRACTS</u>	<u>FUNDING</u>
140	\$29.7 M	148	\$34.0 M

U.S. Army Tank-Automotive RD&E Center (Continued)

Selected Contracts to Commercialize Technology:

* The National Automotive Center issued a Broad Agency Announcement for proposals to develop technologies in specific areas of dual-use to military ground vehicles and the automobile industry, with the intent to stimulate technology development in areas which help the auto industry.

GRANTS AND COOPERATIVE AGREEMENTS

During FY93 a total of \$7.8 M in R&D contract awards are projected to be made to Higher Educational Institutions and Historically Black Colleges.

Donations of Equipment to Universities:

- * Wayne State University - Computer Equipment

URI and Centers of Excellence:

- * University of Wisconsin - Advanced Propulsion
- * Auburn University - Energy
- * University of Delaware - Manufacturing Science
- * Massachusetts Institute of Technology - Intelligent Control Systems
- * University of California, San Diego - Materials
- * Cornell University - Mathematics
- * University of Minnesota - High Performance Computing Research

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
FY92		FY93	
PHASE I	PHASE II	PHASE I	PHASE II
\$607 K	\$2,607 K	\$1,057 K	\$3,047 K

USE OF LABORATORY FACILITIES

TARDEC currently has 3 non-CRDA activities involving company use of its facilities:

- * Cummins Engine Company
 - 1) Testing the cylinder head of an Advanced Integrated Propulsion System (AIPS) single-cylinder engine
 - 2) Conducting a high-temperature oil test (supports the AIPS) in an L10 engine.
- * General Dynamics Land Systems Division - Software configuration management on a TARDEC Vax Computer system.
- * Hughes - Use of TARDEC Vetronic Crew Station Simulator to study tank crew size reduction.

U.S. Army Tank-Automotive RD&E Center (Continued)

COOPERATIVE R&D AGREEMENTS (CRDA)

<u>ACTIVE CRDA's</u>	<u>CRDA's UNDER NEGOTIATION</u>
6	11

Active CRDA's Titles:

- * *Thermal Modeling Software FRED*
Partner: Industry
- * *Class V Driving Simulation*
Partner: Academia
- * *Combustion and Tribology*
Partner: Academia
- * *Hybrid Electric Drive/High Mobility Multipurpose Wheeled Vehicle*
Partner: Industry
- * *Composite Material Prototype*
Partner: Academia
- * *Infrared Imaging Software PRISM*
Partner: Academia

Non-Monetary Contributions:

- * Labor
- * Equipment such as Vehicles

Reasons for Backlog: TARDEC does not have a CRDA processing backlog. However, the CRDAs under negotiation are due to TARDEC or partner researcher workloads as well as partner legal staff/management hesitancy to enter CRDAs.

INTELLECTUAL PROPERTY

<u>PATENTS DURING FY92 & FY93 (through June)</u>			
<u>NUMBER ISSUED</u>	<u>NUMBER OF APPLICATIONS</u>	<u>NUMBER OF LICENSES</u>	<u>AMOUNT OF ROYALTIES</u>
23	25	2	\$ 2,130

Selected Patent Titles:

- * *Hardware Interface for High Speed Video Imaging*
- * *Improved Tow Bar Assembly*
- * *Infinitely Variable Transmission*
- * *Roll Up Jack*
- * *Walking Beam Track Tension Device*
- * *Shock Absorber Bracket and Pin*
- * *Ammunition Compartment Blast Door Lock*
- * *Composite Projectile*

U.S. Army Tank-Automotive RD&E Center (Continued)

Selected Patent Application Titles:

- * *Traction Boot for Tires*
- * *Jointed Assembly Actuated by Fluid Pressure*
- * *Improved Reactive Armor*
- * *Improved Method to Image High Speed Events*
- * *Method to Attach a Plate to Steel Substrate*
- * *Plural Pass Vision System*
- * *Portable In-Field Engine Tester*
- * *Ballistically Protective Air Passage*

Backlog in Patent Applications: There is currently a backlog of 40 patent disclosures, or about 1 year's work. The backlog exists due to the normal practice of operating with a large backlog prior to technology transfer receiving the current importance and can not be reduced because there is no additional staff to eliminate the backlog.

Attorneys Supporting DTT: TARDEC has three attorneys working on domestic technology transfer, CRDAs patents, and licensing. There is one GM-15, two GS-14s, and one secretary. There is no travel budget. The attorneys train engineers in patents and license matters on an individual, as-needed basis.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

TARDEC has spent at least 2 man-years of effort and \$50K in travel, materials, and contractor support costs in supporting the TRP. TARDEC has assisted on 24 proposals in the Development and Deployment Activities and 14 proposals in the Education Activity area, for a total of 38 proposals.

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * National Parks Service - Procurement of trucks
- * National Highway Transportation Safety Administration - Truck rollover and stability analysis
- * Environmental Protection Agency - Vehicle Emissions
- * Department of Energy - Tank armor materials and advanced propulsion
- * Department of Agriculture - Evaluation and test of biologically derived rubber, fuels, and lubricants

Typical Interactions with State and Local Governments:

- * National Automotive Center - Extensive assistance to the domestic automobile industry
- * Society of Automotive Engineers
- * Association of Unmanned Vehicle Systems

Typical Interactions with Industry:

- * Michigan Department of Commerce - Business fair and local outreach

U.S. Army Tank-Automotive RD&E Center (Continued)

Typical Interactions with Academia:

- * Wayne State University - Researchers teaching at the University
- * Oakland University - First-ever robotics competition
- * University of Michigan, Wayne State University, and National Technological University - Offers on-site courses
- * Michigan State University
- * Michigan Technological University

U.S. Army Tank-Automotive RD&E Center (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

Specific plans for improving the technology transfer process:

1. Laboratory Technical Expertise

TARDEC will continue to refine its database on In-House technical expertise, facilities, inventions and marketable technologies. This information helps potential customers more effectively understand opportunities in working with TARDEC.

2. ORTA and DTT Focal Points

The ORTA will seek set-aside funds to foster CRDAs through direct In-House funding of worthy projects. Emphasis on dual-use development and leveraging project funds through CRDAs will continue.

3. Technical Reports and Publications

TARDEC currently awards associates who publish, and this practice will continue.

4. Marketing

Workforce education by the ORTA will shift from a pure emphasis on CRDAs, to educating researchers in basic marketing. The value of effectively presenting TARDEC technology capabilities through publications, meetings and exchange programs will be highlighted.

5. SBIR

Increased coordination between CRDA activities and the SBIR and IR&D programs will be sought. In an effort to encourage leveraging of resources, CRDAs will be used to promote commercialization of successful Phase I and II SBIR projects. The IR&D program will be used to identify potential CRDAs.

6. CRDA's and Laboratory Facilities

The ORTA will continue work force education in CRDAs, and to assist TARDEC organizations and individual associates in setting up CRDAs. Business criteria will govern whether facility usage agreements are CRDAs, or other types of agreements. Rewards for developing CRDAs will be established.

7. Intellectual Property

Workforce education will incorporate basic education in patents and licensing, and assistance for prospective inventors.

U.S. Army Tank-Automotive RD&E Center (Continued)

8. Technology Reinvestment Project (TRP) Efforts

TARDEC will continue to support the TRP. TARDEC will actively seek TRP projects with leveraging potential for TARDEC's mission-critical technology areas.

9. Interactions with non DoD Organizations

TARDEC will promote CRDA activity with Michigan small business, including the use of TARDEC facilities, where appropriate. A computerized Technical Information Center (TIC) has been established at TARDEC. The TIC will subscribe to electronic data services to bring current technology developments to TARDEC associates.

U.S. ARMY WATERWAYS EXPERIMENT STATION

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ORGANIZATIONAL AREAS OF EXPERTISE

Structural hardening, structural dynamics, ground-shock prediction, blast and shock effects, projectile penetration mechanics, intrusion detection, terrorist threat protection, conventional munitions survivability, and explosive effects.

Concrete performance, seismic effects on structures, structural materials, and forensics.

Infrastructure technology in the areas of concrete and steel structures, geotechnical engineering, hydraulics, coastal engineering, electrical and mechanical engineering, and operational management of Corps of Engineers facilities.

Water and land resource management, wastewater management, hazardous waste treatment and disposal, environmental characterization and remediation, environmental health fate and effects, environmental sensing, wetlands, dredging and dredged material disposal, and water quality modeling.

Airfields and pavements, vehicle mobility and trafficability, expedient surfacing, dust control, soil and rock mechanics, foundation design, embankment design, slope stability, seepage analysis, earthquake engineering, engineering geology, and geophysics.

Flood control, navigation, and multi-purpose water resources projects involving rivers, reservoirs, or estuaries. Hydrodynamic multi-dimensional modeling, ship/tow simulation, sedimentation, high velocity channels, and groundwater.

Coastal winds, waves, water levels, tides, currents, and their interaction with coastal sediments and structures. Shore and beach erosion control, coastal flood and storm protection, harbor entrances and coastal channels, and coastal structures.

Computer-aided engineering, computer-aided design and drafting, software engineering, high performance computing, geographic information systems, image processing, data and video compression, communications network management, and scientific visualization.

U.S. Army Waterways Experiment Station (Continued)

UNIQUE FACILITIES

(Available for small commercial firms as well as Defense Contractors)

Riprap Test Facility - Largest curved channel test facility in the U.S. It is used to test and develop design criteria to reduce the cost of riprap in flood control channels.

Mobility Research Center - Includes terrain mapping, vehicle model evaluations, and field testing capabilities; mobility specifications for current and future vehicle procurement are developed for the Army, Air Force, Marines, and Navy. Over 2,500 acres of on/off road test area in various soil conditions are available for use in field testing with vehicle instrumentation tailored to user needs. Engineering modeling studies can also be performed.

Large Scale Poly-Axial Rock Testing System - Capable of subjecting a specimen measuring 3m by 3m by 1m in size to pressures in excess of 8,000,000 pounds-force. Automated control of the tests allows independent control of the three axes of loading. Data acquisition is provided for 48 channels of data with real time data reduction available simultaneously on 2 video screens and 2 plotters.

Pavement Test Facilities - Several facilities are available for testing highway and airfield pavement materials. A 0.7 mile, two-lane road, divided into 15 sections including curves and grades; a 49-ft diameter test track bound on the outer edge by a 7-ft wide portland cement concrete and the inner edge by a 3-ft wide pavement. Various surfacing materials are tested (native soil, crushed aggregate, asphalt, or concrete).

Ship/Tow Simulator - Used to simulate ship motions in restricted waterways in support of navigation channel design problems. Hydrodynamic model includes shallow-water effects, bank effects, currents, wind, and waves.

Hazardous Waste Research Center - Analysis, treatment, and disposal of highly contaminated sediments in the areas of ex-situ bioremediation, chemical treatment, soil washing, low temperature thermal desorption, in-situ bioremediation, dechlorination, solvent extraction, and others. Capabilities for both bench and small pilot scale treatability studies.

Coastal Movable Bed Test Facility - A 76,000 sq ft reinforced concrete testing facility for simulating coastal processes. Directional spectral waves can be generated to study the effects of "real world waves".

Coastal Field Research Facility - Located on a barrier island on North Carolina's Outer Banks, this facility consists of a 1,800 ft long concrete and steel pier, 4,500 sq ft main building housing office and computer facilities, and a 3,300 sq ft annex, all situated on 175 acres with 3,000 ft of ocean and bay frontage. Instrumentation and specialized vehicles are available to support a variety of activities on land and in the water.

Scientific Visualization Center - A unique facility that uses high-end computer graphics techniques combined with video capability to address complex data problems. The Center has high speed communications access to the Army's fourth CRAY-Y-MP supercomputer located at WES as well as national networks.

Projectile Penetration Test Facility - Houses a laboratory 83 mm "gun" developed especially to investigate anti-penetration shielding techniques against a wide range of projectile threats.

U.S. Army Waterways Experiment Station (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA is organizationally located within the Office of Technical Programs and Plans and is staffed by one GS-12 General Engineer who devotes approximately 3/4 man-year of effort on Domestic Technology Transfer and SBIR programs. Additional manpower support is provided by the Office of Counsel on issues related to patents, licensing, and Cooperative R&D Agreements. The budget for such activities directly related to the ORTA is approximately \$200,000. In addition, WES researchers make approximately 500 presentations at professional conferences each year. The estimated budget for this one-on-one, researcher-to-researcher technology transfer is approximately \$1 million.

Publicity:

- * Activities Report
- * Broad Agency Announcement of current interests
- * Fact Sheets on individual technologies

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	224	77

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Approximate Number Published	325	257

Typical Publications and Forums:

- * American Society of Civil Engineers (ASCE) Journal of Environmental Engineering Division
- * ASCE Journal of Materials in Civil Engineering
- * American Society for Photogrammetry and Remote Sensing
- * Journal of Aquatic Plant Management
- * Journal of Coastal Research
- * Sea Technology Magazine

Selected Titles:

- * *Cleaning Up Department of Defense Installations*
- * *Resin Modified Pavement in Airfield Applications*
- * *Modeling Realistic Ship Behavior in Highly Restricted Waterways*
- * *A Decision Support System for Flood Forecasting and Control*
- * *Working with Concretes Based on a High-Performance Blended Cement*
- * *Verification of the Chesapeake Bay Three-Dimensional Numerical Model*

U.S. Army Waterways Experiment Station (Continued)

CONFERENCES AND SYMPOSIA

CONFERENCES AND SYMPOSIA	FY92	FY93 (through June)
Approximate Number Attended	100	86

Selected Conferences and Symposia:

- * Water Quality Enhancement Techniques Workshop, Vicksburg, MS
- * Hurricane Andrew: A Taste of the Future? 1993 National Hurricane Conference, Orlando, FL
- * National Wetlands Engineering Workshop, St. Louis, MO
- * ASCE Coastal Engineering Practice '92, Long Beach, CA
- * Materials Engineering Congress, ASCE, Atlanta, GA
- * ASCE 1993 National Conference on Hydraulic Engineering, San Francisco, CA
- * American Concrete Institute Annual Convention, Dallas, TX
- * 38th Annual Society for Advancement of Materials & Plastics Engineering Symposium, Anaheim

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * ARO Army Summer Faculty Research and Engineering Program - Louisiana State University, East Carolina University, University of Arizona
- * ARO Summer High School Faculty and Science Program
- * U.S. Military Academy
- * Science and Technical College Students - Mississippi State University, & Jackson State University
- * Interagency Personnel Agreements (IPA) - Texas A&M, West Virginia University and Louisiana State University

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
98	\$9.7 M	88	\$8.4 M

Note: Does not include Civil Works contracts.

Selected Contracts to Commercialize Technology:

- * Trenchless Construction - Evaluation of Methods and Materials to Install and Rehabilitate Underground Utilities
Commercialization: Louisiana Tech University Construction Productivity Advancement Research Program (CPAR) Contract to evaluate methods and materials to install and rehabilitate underground utilities with the aim of promoting the commercialization of trenchless technology.
- * In-Situ Device to Determine Lateral Earth Pressure
Commercialization: A SBIR contractor is designing a device to measure lateral earth pressures in-situ.
- * Falling Beam Soil Saw - An Advanced Process for Forming Underground Cutoff Walls
Commercialization: A CPAR contract is developing a soil saw.

U.S. Army Waterways Experiment Station (Continued)

Selected Commercialized Technologies:

- * Developed numerical water quality models which are being used by over 50 consulting engineering firms.
- * Developed bioengineering technology which is being used by several environmental companies to arrest erosion occurring at the toe of dikes protecting wetlands on the Sacramento River.
- * Developed pavement technologies such as microwave recycling of highway materials, drop-cone penetrometer, and airfield repair techniques which have all been commercialized.

GRANTS AND COOPERATIVE AGREEMENTS

Donations of Equipment to Universities:

- * Alcorn State University - Electronic Equipment
- * University of Washington - Otolith Equipment
- * University of Maryland, Eastern Shore - Computer Equipment
- * University of Massachusetts, Amherst - Loaned a Geanor Simple Shear Device

Investments in University Facilities:

- * University of Alaska - Grant for Supercomputer and peripheral Equipment (\$19M)
- * Rice University - Grant for Equipment and Facilities (\$225K)

Education Partnerships:

- * Alcorn State University
- * Vicksburg-Warren County Public School District
- * Lewisville Lake Environmental Learning Area (includes Southern Methodist University, Texas A&M University, Texas Christian University, Texas Woman's University, University of North Texas, and the University of Texas at Arlington)

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
FY92		FY93	
PHASE I	PHASE II	PHASE I	PHASE II
\$206 K	\$466 K	\$67 K	\$1,221 K

USE OF LABORATORY FACILITIES

Typical Uses of Facilities:

- * University of New Orleans - Used the Geophysical Training Facility for a field laboratory.
- * City of Vidalia, LA - Agreement to study fixed and moveable bed models on the Murry Hydroelectric Project.
- * Port of Los Angeles - Agreement to conduct various types of model studies which use unique wave modeling facilities.

U.S. Army Waterways Experiment Station (Continued)

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
13	1

Selected Active CRDA's Titles:

- * *Non-Destructive Testing and Evaluation of Pavements*
Partner: Local Government
- * *Masonry Research for Limit States Design*
Partner: Industry
- * *Application of Roller Compacted Concrete Technology to Roadway Paving*
Partner: Academia
- * *Trenchless Construction*
Partner: Industry
- * *Stabilization of High Plasticity Clay Soils Using Discrete Fibers*
Partner: Industry

Lab Investment: \$1886K in FY92 and \$2526K in FY93

Non-Monetary Contributions:

- * Services
- * Equipment
- * Technical Information

Reasons for Backlog: There is currently not a backlog.

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
5	4	N/A	N/A

Selected Patent Titles:

- * *Computer Controlled MW Oven for Water Content Determination; 5,085,527*
- * *Explosive Stemming Device; 5,092,245*
- * *Device for Measuring Reflectance/Fluorescence in In-Situ Soil; 5,128,882*
- * *Computer Controlled Ball Valve; 5,178,361*
- * *Modified Tribar Armor Unit; 5,176,466*

U.S. Army Waterways Experiment Station (Continued)

Selected Patent Application Titles:

- * *Technique for Using Electrolytes to Control the Hardening of Binder on Cement Pastes*
- * *Use of Separated Electrode System in Electrolytically Setting or Hardening Reactive Pastes*
- * *Quick-Release Trigger Mechanism for Large Loads*
- * *A Technique and Apparatus for Using a Chemical Indicator Tape with a Fiberoptic Cone Penetrometer to Detect Contaminants in Soil*

Backlog in Patent Applications: There is a backlog of approximately 15 applications. The backlog is due to having only one Patent Attorney at WES.

Attorneys Supporting DTT: WES has two Attorneys who provide support, as needed, to the DTT program. They provide counsel to WES engineers and scientists regarding patent and license requirements and responsibilities through personal interviews. They have also invited Corps HQ patent counsel to WES on multiple occasions for interviews and seminars with WES engineers and scientists. The cumulative salary of the two WES attorneys is \$118,765 per year though only 20 percent of their time is devoted to DTT activities.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

WES has received two inquiries regarding partnering in a TRP proposal and has agreed to participate in one proposal. Approximately 40 man-hours have been expended evaluating proposals and discussing potential TRP programs with industry.

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * U.S. Coast Guard and National Oceanic and Atmospheric Administration - Electronic Chart Display Information System (ECDIS)
- * Interagency Research Coordination Conference - a biannual conference to discuss research programs of common interest with:
 - * Tennessee Valley Authority
 - * Bureau of Reclamation
 - * Bonneville Power Administration
 - * Western Area Power Administration
- * Federal Bureau of Investigation, Department of State, and Environmental Protection Agency - Use of explosives at a Superfund Cleanup Site
- * Department of Transportation and Department of Energy-Argonne National Lab - Development of magnetically levitated (MAGLEV) transportation
- * Federal Aviation Administration - Research on the seismic response of control towers.

Typical Interactions with State and Local Governments:

- * Memoranda of Understandings (MOU) with several states
- * Hawaii Department of Transportation - Physical and numerical investigations to optimize the design of enlargements of the entrance channel and inner harbor at Barbers Point, Hawaii
- * Iowa, Colorado, and Texas Departments of Transportation - Evaluation of computer software for on-line quality control of portland cement concrete production

U.S. Army Waterways Experiment Station (Continued)

Typical Interactions with State and Local Governments (Continued):

- * Pittsburgh International Airport - Field test and evaluation of concrete quality control by heat signature and maturity methods
- * New York Department of Transportation - Rehabilitation of locks on the Erie and Oswego Canals using a precast stay-in-place forming system
- * Orange County California - Hydraulic model study of San Juan Creek

Typical Interactions with Industry:

- * Scripps Oceanographic Institute - Harbor wave modeling and infragravity waves
- * Sith Energies, Inc. - Model tests to study retrofit of a low-head hydropower plant at Melvin Price L&D, Mississippi River
- * A ready-mix concrete plant in Louisville, Kentucky - Conduct a seminar and field demonstration on the use of DELVO technology
- * Various private research companies - Provide technical consultation and/or contract R&D
- * National Science Foundation - Study tsunami-induced runup on beaches

Typical Interactions with Academia:

- * Scientists are adjunct professors at various universities
- * R&D contracts with many universities
- * Interagency Personnel Agreements from several universities
- * Visited by professors throughout the world for information and consultation

U.S. Army Waterways Experiment Station (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER (DTT)

1. Formalize DTT Policy and Procedures for WES

A manual will be published defining WES policy and procedures related to Domestic Technology Transfer. Patent and Cooperative Research & Development Agreement (CRDA) issues will be addressed, as well as issues related to technical assistance/information.

2. Develop Training Materials for Engineers and Scientists

To reinforce the Policies and Procedures Manual, we will prepare a PC-based slide show covering Domestic Technology Transfer laws and issues. The slide show will be distributed to our engineers and scientists as an executable file on floppy disk. Quick reference cards on CRDAs, Patents, and Licensing will accompany the disk.

3. Technology Assessment

WES engineers and scientists will be tasked to prepare fact sheets on technology, techniques, and software being developed at WES that may have commercial application. These will be reviewed and used to identify candidates for CRDAs, patent applications, and patent licensing actions.

4. Outreach

A 10 foot long trade show display will be completed for use in publicizing WES technologies available for CRDAs and licensing. We will begin development of literature products to support Domestic Technology Transfer marketing efforts such as trade shows and economic development workshops.

WALTER REED ARMY INSTITUTE OF RESEARCH

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ORGANIZATIONAL AREAS OF EXPERTISE

Development of vaccines directed against infectious agents of military concern using recombinant and molecular technology along with tissue culture, animal models, and human studies conducted both in the U.S. as well as endemic areas throughout the world.

Development of new drugs directed against infectious agents endemic to areas of military concern utilizing computer modeling, molecular techniques, tissue culture, animal models, and human studies done in the U.S. as well as endemic areas in other countries.

Development of new and unique vehicles and adjuvants for drug/vaccine delivery that will amplify and direct the response to these agents resulting in reduced cost, increased safety, and improved efficiency.

Development of new blood products useful in far-forward areas for resuscitation of shock due to trauma and hemorrhage.

Development of bioabsorbable materials used to control bleeding or to serve as tissue adhesives and temporary matrices for the development of bone or tendon.

Modeling of injury to the upper airways, lung, or Gastrointestinal Intestinal (GI) system from blast overpressure.

Identification of tissue interactions and types of injury related to directed energy sources (microwaves or lasers) and determination of threshold levels for such injury.

Identification of factors most relevant to combat stress and unit cohesion and development of approaches to mitigate stress and enhance cohesion.

Development of vaccines and/or drugs to prevent infection or mitigate the effects of selected unusual biologic organisms and their toxins.

UNIQUE FACILITIES

GMP Vaccine Pilot Production Facility - Facility provides the capability to produce batches of vaccine under Good Manufacturing Practices (GMP) standards required by the Food and Drug Administration (FDA) for human testing in large Phase III efficacy trials.

Walter Reed Army Institute of Research (Continued)

GMP Peptide Synthesis Facility - Facility provides the ability to synthesize candidate peptides (portions of proteins) under FDA required GMP standards that can be incorporated into human vaccines.

Vaccine/Drug Delivery Systems - Four different types of sophisticated delivery systems (several patented or being patented by WRAIR investigators) provide the capability of markedly amplifying and directing the immune response to achieve maximum efficacy for any given vaccine.

Serum Repository - Well documented and catalogued repository of approximately 11 million serum samples from all active duty and reserve military across the continental U.S. over the last 8 years. This repository is unavailable anywhere else and provides the ability to identify serum markers and establish epidemiology of disease processes from any region of the country.

U.S. Army HIV Data System (USAHDS) Database - Massive database links demographic and clinical data on individuals to the 11 million samples in the Serum Repository.

OCONUS Laboratories - Stable, well established, high quality laboratories on four continents provide the capability to study the efficacy of relevant drugs and vaccines in regions where the diseases of concern are endemic.

Blast Overpressure Model - Integrated computer model of several programs that together will predict the probability and severity of tissue injury to the upper airways, lung, or GI system resulting from concussive noise waveforms entered into the program.

Shock Tube - Unique and reproducible system to generate concussive noise waveforms and permit laboratory studies of tissue injury or the effects of such waveforms on physical performance.

Performance Assessment Technology - Battery of standardized tools sensitive to defining disruption of a spectrum of cognitive abilities under conditions of stress, sleep deprivation, and environmental disturbances.

Behavioral Models - Unique and well documented spectrum of sophisticated animal models that address issues from behavioral economics to factors crucial to combat stress.

Resuscitation Models - Highly technical models that provide the ability to study sensors, drugs, and interventions useful to monitor and reverse hemorrhagic shock with robust, well documented, computer controlled large and small animal model systems with closed loop resuscitation algorithms based on neural nets and fuzzy logic controllers capable of outcome prediction.

Automated 3-Dimensional Tissue Culture System - Provides the ability to support skin, bone, and bone marrow cultures for transplantation or tissue expansion.

Remote Monitored Digital Microscope Imaging System - Provides the ability to remotely monitor and control the imaging of cells and tissues currently grown on Space Shuttle flights in the Automated 3D Tissue Culture System.

Walter Reed Army Institute of Research (Continued)

OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA)

The ORTA chief is a Lieutenant Colonel who performs ORTA functions nearly full time. Additional ORTA support is provided by the Associate Director for Research Marketing and Policy Development and the Deputy Associate Director for Research Management who devote 25 percent and 5 percent, respectively, of their time to ORTA functions. The ORTA budget in FY92 was \$100K and \$150K in FY93.

Publicity:

- * WRAIR Biannual Report
- * WRAIR Historical Report
- * Laboratory of the Year Submission
- * Federal Register Announcements
- * Montgomery County High Technology Council Meetings

TECHNICAL REPORTS

<u>TECHNICAL REPORTS</u>	<u>FY92</u>	<u>FY93 (through June)</u>
Submitted to DTIC	111	68

PUBLICATIONS

<u>PUBLICATIONS</u>	<u>CY92</u>	<u>CY93 (through June)</u>
Approximate Number Published	468	456

Typical Publications and Forums:

- * Journal of the American Medical Association
- * Journal of Experimental Medicine
- * Journal of Forensic Sciences
- * Journal of Infectious Diseases
- * Physiology and Behavior
- * Vaccine

Selected Titles:

- * *Recent Advances in Understanding Clotting and Evaluating Patients with Recurrent Thrombosis*
- * *Characterization of Naturally Acquired Antibodies to the Non-Repetitive Flanking Regions of the Circumsporozoite Protein of Plasmodium-Falciparum*
- * *Rapid Generation of Specific Protective Immunity to Francisella-Tularensis*
- * *Neuroreceptors and Glucose-Metabolism in Epilepsy as Studied by Pet Scanning*
- * *Abnormal Cardiovascular-Responses Induced by Localized High-Power Microwave Exposure*
- * *Clinical and Laboratory Observations Following Oral or Intramuscular Administration of a Live Attenuated Hepatitis-A Vaccine Candidate*

Walter Reed Army Institute of Research (Continued)

CONFERENCES AND SYMPOSIA

Selected Conferences and Symposia:

- * American Society of Microbiology
- * Federal Laboratory Consortium
- * International Association Biological Standardization Symposium
- * Safety and Efficiency of 2nd Generation Vaccines
- * American Gastroenterology Association
- * International Society of Behavioral Neurosciences
- * The Society for Neurosciences
- * American Society for Tropical Medicine and Hygiene
- * Federation of American Societies for Experimental Biology
- * The Shock Society
- * Association for the Advancement of Medical Instrumentation
- * American Society for Biochemistry and Molecular Biology
- * American Society of Nephrology

EXCHANGE PROGRAMS

Selected Exchange Programs:

- * National Research Council Postdoctoral Associateship Program
- * Department of Defense Science and Engineering Internship Program for High School Students
- * Science and Technology College Student Contractors
- * Stay in School Programs
- * Partners in Education of the DC Public Schools
- * Federal Intergovernmental Personnel Act

RDT&E CONTRACTS

FY92		FY93	
NUMBER OF CONTRACTS	FUNDING	NUMBER OF CONTRACTS	FUNDING
130	\$24.2 M	122	\$20.6 M

GRANTS AND COOPERATIVE AGREEMENTS

	FY92		FY93	
	NUMBER	FUNDING	NUMBER	FUNDING
GRANTS	28	\$18.5 M	23	\$4.9 M
AGREEMENTS	5	\$0.5 M	9	\$18.5 M

Walter Reed Army Institute of Research (Continued)

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAMS

SBIR FUNDING			
PHASE I	FY92 PHASE II	PHASE I	FY93 PHASE II
\$50 K	\$642 K	N/A	\$893 K

COOPERATIVE R&D AGREEMENTS (CRDA)

ACTIVE CRDA's	CRDA's UNDER NEGOTIATION
33	25

Selected Active CRDA's Titles:

- * *Immunologic Approaches to Prevent or Treat Infectious Diseases by Using Recombinant Viral Vectors*
Partner: Industry
- * *Composite Formulations of Insect Repellents*
Partner: Industry
- * *Development of Drugs, Vaccines, and Other Medical Products for the Prevention and Treatment of Malaria and Other Parasitic and Infectious Diseases*
Partner: International Non-Profit Organization

Criteria for Deciding if Income is Desired: If the Government will make a significant investment in conducting research and/or evaluation of a company's product, or if the research and development may lead to a commercially viable product, then WRAIR will request that the Company partially reimburse WRAIR in compensation for the R&D effort in the program.

Non-Monetary Contributions:

- * Personnel provided by Industry
- * Equipment provided by Industry

Reasons for Backlog: Company legal offices require additional education on Technology Transfer and CRDA's.

INTELLECTUAL PROPERTY

PATENTS DURING FY92 & FY93 (through June)			
NUMBER ISSUED	NUMBER OF APPLICATIONS	NUMBER OF LICENSES	AMOUNT OF ROYALTIES
6	37	10	\$22 K

Walter Reed Army Institute of Research (Continued)

Selected Patent Titles:

- * *Nucleic Acid Probe and Method for the Rapid Detection of Typhoid Fever Bacteria*; 5,055,394
- * *Hybridoma Cell Lines and Monoclonal Antibodies to Clostridium Difficile Toxins A and B*; 5,071,759
- * *Photo Processing Work Station*; 5,077,570
- * *Potentiation of Immunotoxin Action by Brefeldin A*; 5,112,607
- * *Bis-Methylene Ether Pyridinium Compound Preparation*; 5,130,438
- * *Compounds Exhibiting Anti-Parasitic Activity and a Method for Their Use*; 5,204,352

Selected Patent Application Titles:

- * *Synthetic Peptide Protective Against Malaria and Encoding Genes*
- * *Heterocyclic and Aromatic Thiosemicarbizones Useful in the Treatment of Filariasis*
- * *A Vaccine for Induction of Immunity to Malaria*
- * *Oral Vaccine for Immunization Against Enteric Disease*
- * *Protein-Free Medium for Cell Cultivation*
- * *Administration of Liposomes Containing Peptides or Proteins Including CTL Epitopes of HIV Proteins*

Backlog in Patent Applications: Headquarters, U.S. Army Medical Research and Development Command (USAMRDC) does not have a backlog in work on patent applications. However, USAMRDC has inherited invention disclosures from HQDA. These invention disclosures will soon be processed by a contractor in preparation for conducting patent searches and filing patent applications.

Attorneys Supporting DTT: Attorney support for WRAIR is provided by HQ USAMRDC, Fort Detrick, MD. One GS-14 patent attorney is devoted full time to patent prosecution and licensing. A second GS-14 general attorney and a Lieutenant Colonel attorney devote approximately 50 percent and 30 percent, respectively, of their time to technology transfer activities. The current travel budget is \$7,500.

TECHNOLOGY REINVESTMENT PROJECT (TRP) EFFORTS

WRAIR cooperated with the Maryland Department of Economic and Employment Development in their submission to the Advanced Research Projects Agency (ARPA). The proposal is for the "Maryland Health Care Product Alliance" and is being evaluated along with the rest of the TRP proposals.

Walter Reed Army Institute of Research (Continued)

INTERACTIONS WITH NON DOD ORGANIZATIONS

Typical Interactions with Other Government Agencies:

- * National Aeronautics and Space Administration - Space tissue loss project
- * National Institutes of Health - Various projects including vaccine development
- * Food and Drug Administration - Investigational new drug applications (drugs and vaccines) and compliance with good manufacturing practices
- * Department of Agriculture - Material Transfer Agreements on antiparasite drug testing.
- * Department of State - Special foreign activity laboratories; epidemiology and drug and vaccine field testing
- * World Health Organization - Drug and vaccine development; WRAIR also provides expert consultantship
- * Veterans Administration - Numerous cooperative grants

Typical Interactions with State and Local Governments:

- * State of Maryland - Support of Department of Economic and Employment Development activities
- * Montgomery County High Technology Council - Member
- * Greater Silver Spring Chamber of Commerce - Member

Typical Interactions with Industry:

- * Numerous interactions through CRDA's and Material Transfer Agreements in the following areas:
 - * Japanese E Encephalitis Vaccine Development
 - * HIV drug and vaccine testing
 - * Insect repellent development and efficacy
 - * Antibiotic field testing
 - * Malarial drug and vaccine field testing
 - * Hepatitis A vaccine trials

Typical Interactions with Academia:

- * University of Georgia - Schistosomiasis modeling and drug testing
- * University of Maryland - Attenuation of bacterial strains for diarrheal vaccines
- * Virginia Polytechnic Institute and State University - Brucellosis vaccine development
- * University of Hawaii - Malaria antigen development for vaccines
- * Duke University - Development of Malaria enzyme inhibitors (in negotiation)
- * Rutgers University - Development of Leishmaniasis topical repellants

Walter Reed Army Institute of Research (Continued)

PLANS FOR IMPROVING DOMESTIC TECHNOLOGY TRANSFER

In 1994, the USAMRDC will improve its technology transfer program by emphasizing marketing and licensing while solidifying the existing Cooperative Research and Development Agreement process.

Specific Plans

1. Finalization of a local supplement to AR 70-57, which has been approved by Headquarters Department of the Army. This local supplement will contain three model Cooperative Research and Development Agreements:
 - (1) A long-form for large projects
 - (2) A short-form for simple transfers of material or information to non-Government parties
 - (3) A material transfer model for transfer of non-commercial material or information to the Government for testing.

Final issuance of this supplement will solidify the program by providing a minimal uniform system throughout the Command without curtailing flexibility.

2. Training of all scientists within the Command on basic intellectual property law, the technology transfer process, and ethics issues unique to technology transfer.
3. Detailed training of ORTAs on commonly negotiated provisions of CRDAs.
4. Establishment of a multi-discipline invention review committee to prioritize invention disclosures and identify inventions for early marketing efforts.
5. Begin to computerize the patent docketing system for the command which will again aid in marketing efforts.

SECTION II

EXAMPLES OF ARMY COMMERCIALIZED TECHNOLOGIES

EXAMPLES OF U.S. ARMY COMMERCIALIZED TECHNOLOGIES

New Oscillator/Amplifier Components

The U.S. Army Research Laboratory through its Electronics and Power Sources Directorate (EPSD), located at Fort Monmouth, N.J., together with Trontech, Inc., located in the proximity of Fort Monmouth, have been conducting an extremely successful Cooperative Research and Development Agreement (CRDA) program which addresses an number of government and private sector needs. As a result of this cooperative program, the following successes have been reported and documented under the CRDA.

Trontech has designed a millimeter wave communications relay and distribution system for extending cable television service to high density urban areas where it is impractical to use conventional cable service. EPSD provided Trontech with test facilities, advanced antenna design techniques, and transceiver/antenna evaluation for this new system design.

Trontech has pioneered cellular power amplifiers for cell site transmitters and provided much of this technology to the cellular phone industry. New amplifier designs, having stringent requirements for high purity signals, can only be verified with specialized equipment such as is found at EPSD. EPSD has extensive experience in this area of technology and is currently working with Trontech in the evaluation of developmental amplifier units.

Dual Mode Quartz Thermometric Sensing Device

The Electronics and Power Sources Directorate (EPSD) of the Army Research Laboratory has signed seven partially exclusive Patent Licensing Agreements (PLA's) with three large corporations and four small businesses. The EPSD patent entitled, *Dual Mode Quartz Thermometric Sensing Device*, has wide range commercial applications, such as, in communications (satellite, cellular phones and pagers), navigation (Global Positioning Systems) telecommunications (digital), and highly accurate digital thermometers.

The significance of this invention is that a new and novel method has been developed for use in microcomputer-compensated crystal oscillators (MCXO's), which allows temperature compensation without the use of ovens or conventional temperature-compensating techniques, which are usually associated with large, power hungry, oven-controlled sources with long warm-up times. This new thermometric method allows for a quartz resonator, similar to those used in quartz watches, to sense its own temperature, thereby overcoming limitations of using external temperature sensors that provide the information necessary for improving frequency stability over temperature. The licensees are Motorola, Ball Efratom, Frequency Electronics, Q-Tech, Vectron, Piezo Crystal and Piezo Technology.

Examples of U.S. Army Commercialized Technologies (Continued)

Sequential Electrochemical Reduction

The Electronics and Power Sources Directorate of the Army Research Laboratory has jointly developed Sequential Electrochemical Reduction Analysis (SERA) with Rockwell Science Center.

The SERA method permits non-destructive assessment of solderability loss associated with surface oxides on metals, including printed circuit board through-holes and surface pads. Currently, printed circuit board solderability is tested by destructive and subjective methods. SERA reportedly predicts solderability by electrochemically reducing the oxides from the surface of the plated through-hole or pad. The Army Research Laboratory estimates that resulting cost reduction for electronic systems through the application of this technique could reach \$100 million a year within the Department of Defense.

Geographic Resources Analysis Support System (GRASS)

The U.S. Army Construction Engineering Research Laboratories Environmental Lab was a winner in the 1993 Federal Laboratory Consortium competition for excellence in technology transfer. The awards to Mr. William Goran and his team recognize their significant accomplishments in transferring Geographic Resources Analysis Support System technology from the defense to the private sector.

GRASS provides management tools to Army environmental planners and land managers. GRASS also has many applications for Civil Works project planning and design. GRASS has many capabilities, including the handling of different data representations such as raster (or grid cell) data, vector (or line) data, point data, and imagery (satellite or aerial photographic) data. The ability to link to a data base management system for additional data storage or definition is also present.

Besides military installation planners, GRASS users now include Corps districts and division, the Soil Conservation Service, the National Park Service, and U.S. Geological Survey, the Federal Bureau of Investigations, National Aeronautics and Space Administration, and many universities, commercial firms, and State and local organizations.

Shelf Stable Bread Products

Successful development of shelf stable pouch bread products required extensive studies on the mechanisms of the complex chemical reactions that limit the storage stability of bakery products. The U.S. Army Natick Research, Development and Engineering Center and several commercial baking firms conducted extensive studies to define the quality deficiencies of stored bakery products and to develop formulations and processes that retard or inhibit the degradation processes. This unique technology has now been applied to the development of novel shelf stable products such as burritos, pizza and deli sandwiches, in addition to a new line of shelf stable pound cakes. Companies currently producing shelf stable bakery products include Sterling Foods, Miss King's Kitchens Incorporated, Oregon Freeze Dry Incorporated, and RAFCO.

Examples of U.S. Army Commercialized Technologies (Continued)

Synthetic Down Batting

A staple-bonded batt was developed, which is now commercially available under the trade name Primaloft. Primaloft is comprised of 85% 0.5 denier per filament (dpf) polyester fibers and 15% 4.0 dpf bicomponent polyester binder fibers. This synthetic highloft alternative, modeled after waterfowl down, will provide the insulating, compression, and recovery properties of down but unlike down will maintain its insulating value when wet. Primaloft can now be found in designer apparel, ski wear, extreme weather wear, gloves sleeping bags, comforters and pillows. In 1991, Primaloft won an R&D 100 Award, sponsored by R&D Magazine, which was awarded jointly to U.S. Army Natick Research, Development and Engineering Center and Albany International.

Dental Liquid Meals

The development of a ration system designed for patients who cannot eat solid food due to eating disorders, such as broken jaws and other dental injuries, was requested by the Office of The Surgeon General. Liquid diets previously used in hospital feeding required substantial preparation time and equipment and were not acceptable to patients. The Dental Liquid Ration developed by U.S. Army Natick Research, Development and Engineering Center consists of dehydrated powders that, when reconstituted with water, are sippable through a straw and taste like normal components of a meal.

In FY92, the Dental Liquid Ration was accepted by the Surgeon General and is now being procured for hospital use. A Cooperative Research and Development Agreement was initiated with Land O'Lakes, Procor Technologies (now Advanced Food Science Incorporated) to apply the developed technologies to industrial processes for commercialization of the ration. Thermo Pac, Incorporated, Stone Mountain, GA, has completed a commercial production of the 36 food products to demonstrate producibility.

Ultraviolet/Ozone Cleaning Technology

The ultraviolet (UV)/ozone cleaning technology was invented and developed in-house by Army researchers at the Electronics and Power Sources Directorate of the Army Research Laboratory. The technology results in near-atomic cleanliness levels; it is simple and inexpensive to apply. At least six manufacturers in the USA and Japan are making UV/ozone cleaners according to the Army invention. Although the method was originally developed for cleaning quartz resonators, it is now widely used in the semiconductor, optical coating, plating, and welding industries.

Examples of U.S. Army Commercialized Technologies (Continued)

Laser and Electro-Optic Control Systems

The Army developed laser and electro-optic control systems that provided early designs for today's systems in fiber-optic communications, laser compact disk players, laser printers, and laser surgery. Surgeons have used the laser's intense, narrow beam of light to "weld" detached retinas and to cut and cauterize tissues in mere fractions of a second without damaging surrounding healthy tissue.

Image Intensification

ITT, Roanoke, Virginia, is about to market a commercial night vision binocular. This device used second generation image intensification technology which was a direct off-shoot from U.S. Army Night Vision and Electronic Sensors Directorate sponsored developments. These devices currently have a recommended retail price of approximately \$2400. If current efforts are successful significant price reductions could occur, the goal of which is to get under \$1000 to compete with Russian imports. ITT has been a formal supporter of people with night blindness through the Retinitis Pigmentosa Foundation (RP).

Far Infrared Thermal Imaging (FLIR)

FLIR Systems, Inc. has fielded enhanced first generation FLIR systems for commercial use and has recently joined with Bell Helicopter Textron, Inc. to integrate and market their Model 2000 A/B FLIR system in rotary and fixed wing commercial aircraft.

Uncooled FLIR Sensor Technology developed under contract with U.S. Army Night Vision and Electronic Sensors Directorate could revolutionize automobile driving technology in the future. General Motors is expected to have an uncooled thermal imaging sensor option available on their Cadillac automobiles in the 1995 model year. This device will feature a display which will indicate potential road hazards and provide warning of obstacles when driving at night and under inclement driving conditions such as cyclists, animals, abandoned vehicles, pedestrians, and etc.

Structural Foams

A hip joint manufacturer has signed an agreement to use structural foams for musculoskeletal applications, pending approval from the Food and Drug Administration. The Automotive Industry is also looking at utilizing the material as part of its exhaust systems to control volatile organic content emission levels. The basis for manufacturing structural foams was developed to insulate hot gas nozzles in rockets through the U.S. Army Space and Strategic Defense Command's Small Business Innovation Research program with Ultramet, Incorporated.

Examples of U.S. Army Commercialized Technologies (Continued)

Water Purification

Many emergency shelters now have the capability of treating, storing, and distributing potable water using Reverse Osmosis Multi-Element Modules developed by the U.S. Army Belvoir Research Development and Engineering Center. These modules enable the user to quickly and easily produce potable water from most water sources including salt water.

Also, third world countries are currently using Electrolytic Sterilization for sterilizing potable water. Electrolytic Sterilization uses mixed oxidants to remove the taste of chlorination from disinfected water and was developed by the U.S. Army Belvoir Research Development and Engineering Center.

Optical Waveguides

Over 50 one- to four-channel wavelength division multiplexers have recently been marketed commercially by Physical Optics Corporation. The wavelength division multiplexers are used in space-based surveillance networks, commercial computer networks, communications applications, fast optical data buses, fanouts, multichip module optical interconnects, and chip-level spectrometers. The wavelength division multiplexers were developed as a result of U.S. Army Space and Strategic Defense Command's development of optical waveguides through a Small Business Innovation Research program with Physical Optics Corporation.

Ballistic Protective Materials

Numerous body armor items developed by the U.S. Army Natick Research Development and Engineering Center are being manufactured commercially. Civilian law enforcement officials, the Secret Service, and the Federal Bureau of Investigation all are using the highly oriented, high modulus, low elongation polymeric-based fibrous ballistic protective materials. Many lives have been saved as a result of the development of the ballistic protective materials.

Anti-Malarial Drugs

Mefloquine and halofantrine are anti-malarial drugs which were developed in the 1950's at the Walter Reed Army Institute of Research and were commercialized in the 1980's in Europe. They are now approved for use in the United States.

Examples of U.S. Army Commercialized Technologies (Continued)

Burn Dressing

Sulfamylon cream is a burn dressing developed at the U.S. Army Institute for Surgical Research. It is commercially available and widely used in the United States.

Customized Protein Production Kit

A ploymerase chain reaction kit enabling the production of customized proteins in a totally in vitro process was invented at Walter Reed Army Institute of Research and is now commercially available.

Vaccine Development Tool

An invention to reduce error rate and increase throughput for accurate production of synthetic peptides for ascertaining antibody reactivity was made at Walter Reed Army Institute of Research and is now commercially available.

Shock Treatment

MAST trousers were developed at the U.S. Aeromedical Research Laboratory and are now standard treatment for early treatment of shock.